NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

PERSONNEL RETENTION POLICY AND FORCE QUALITY: TWICE-PASSED STAFF SERGEANTS

by

Mark T. Fitzgerald

June 2015

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REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704–0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202–4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704–0188) Washington DC 20503.			
1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** June 2015	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE PERSONNEL RETENTION POLICY AND FORCE QUALITY: TWICE-PASSED STAFF SERGEANTS			**5. FUNDING NUMBERS**
6. AUTHOR(S) Mark T. Fitzgerald			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943–5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number NPS.2015.0011-IR-EP5-A.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE** A

13. ABSTRACT (maximum 200 words)

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14. SUBJECT TERMS USMC, Marine Corps, manpower, personnel, inventory, policy, 2P, twice passed, Staff NCO, staff sergeant, retention, reenlistment, promotion, promotion timing, fast-promoting, slow-promoting, retirement, regression, predictor, success, performance, quality, value added, productivity, Markov, implementation, enlisted career force controls, up-or-out, force-shaping, attrition hazard, leadership effect, institutional cost			**15. NUMBER OF PAGES** 153
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UU

NSN 7540–01–280–5500

Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

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PERSONNEL RETENTION POLICY AND FORCE QUALITY: TWICE-PASSED STAFF SERGEANTS

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
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LIST OF ACRONYMS AND ABBREVIATIONS

2P	twice passed for promotion
2P E6	twice-passed Staff Sergeant
A-PES	Automated Performance Evaluation System
AFADBD	Armed Forces Active Duty Base Date
AFQT	Armed Forces Qualification Test
AIC	Akaike Information Criterion
AUC	Area Under the Curve
BIC	Bayesian Information Criterion
CFT	Combat Fitness Test
DMDC	Defense Manpower Data Center
DoD	Department of Defense
E1	Private
E2	Corporal
E3	Lance Corporal
E4	Corporal
E5	Sergeant
E6	Staff Sergeant
E7	Gunnery Sergeant
E8	First Sergeant / Master Sergeant
E9	Sergeant Major / Master Gunnery Sergeant
EAS	End of Active Service
ECFC	Enlisted Career Force Controls
FTAP	First Term Alignment Plan
FTE	Full-Time Equivalent
FY	Fiscal Year
GAR	Grade Adjusted Recapitulation
HYT	High Year of Tenure
M&RA	Manpower & Reserve Affairs
MMEA	Enlisted Assignment Branch, M&RA
MMEA-1	Enlisted Retention Section, MMEA

MOS	Military Occupational Specialty
MPP	Manpower Plans, Programs, and Budget Branch, M&RA
MPP-20	Enlisted Plans Section, MPP
NJP	Non-Judicial Punishment
PFT	Physical Fitness Test
RELM	Reenlistment, Extension, and Lateral Move
ROC	Receiver Operating Characteristic
SCM	Summary Court-Martial
SPCM	Special Court-Martial
STAP	Subsequent Term Alignment Plan
TERA	Temporary Early Retirement Authority
TFDW	Total Force Data Warehouse
TFRS	Total Force Retention System
TIG	Time in Grade
TIS	Time in Service
VSP	Voluntary Separations Pay

EXECUTIVE SUMMARY

In the Marine Corps, Staff Sergeants (E6) twice-passed (2P) for promotion to Gunnery Sergeant lower the quality of the enlisted force, slow promotion rates, and carry an institutional cost. The objectives of this study are to determine predictors of 2P likelihood, evaluate the efficacy of retention policy alternatives, and investigate institutional costs of retaining 2P Staff Sergeants in terms of productivity loss, excess subordinate attrition, and retirement obligations. The three policy alternatives considered are the base case, a quality screen at reenlistment, and a policy of non-retention for 2P Staff Sergeants. The key assumption for this analysis is that the promotion system is efficient, promoting the best and most highly qualified. The key limitation for this study is that the actual impact of Staff Sergeants on unit productivity and attrition is unknown.

A logistic regression uses data from the time of a Staff Sergeants Zone C reenlistment to identify eight predictors of 2P likelihood, $\pi(x)$. AFQT Score (x_{AFQT}), PFT Score (x_{PFT}), Commander's Recommendation (x_{CORec}), MCMAP Belt (x_{MCMAP}), Adverse Material In-Grade ($x_{AdverseInGrade}$), Adverse Material Prior to Staff Sergeant ($x_{AdversePrior}$), Outside Maximum Weight by Height (x_{Taped}), and Black racial identification ($x_{Race(Black)}$) are significant predictors, with coefficients as identified in Table 1.

Table 1. *Logistic Regression Model of 2P Likelihood Results.*

Term	**Estimate**	**Standard Error**	**Chi-Square**	**p-value**	**Odds-Ratio**	**Variable Importance**
Intercept	3.3	0.4	75	< 0.0001	-	-
x_{PFT}	– 0.017	0.001	346	< 0.0001	0.037	0.37
$1/x_{CORec}$	12.1	0.9	170	< 0.0001	8,730	0.23
$x_{AdverseInGrade}$	1.22	0.09	172	< 0.0001	11.4	0.22
$\log(x_{MCMAP})$	– 0.64	0.07	77	< 0.0001	0.32	0.07
$x_{Race(Black)}$	0.20	0.03	34	< 0.0001	1.5	0.03
x_{AFQT}	– 0.009	0.002	30	< 0.0001	0.5	0.03
x_{Taped}	0.18	0.04	25	< 0.0001	1.4	0.02
$x_{AdversePrior}$	0.12	0.04	10	0.0012	1.3	0.01

This analysis uses a Markov model, illustrated in Figure 1, to determine the impact of 2P Staff Sergeant policy alternatives on the enlisted promotion system. Each policy alternative uses optimization, combined with historical data and target inventories, to compute steady-state transition probabilities. The base-case scenario uses historic 2P E6 transition rates to establish a baseline for policy comparison. The non-retention policy denies further service to Staff Sergeants following a second pass for promotion, increasing the wastage rate to 100 percent for 2P E6 to attrition. The quality screen uses a 20-percent reduction in approved reenlistments, which increases the probability of transition from E6 to attrition and decreases the probability of transition from E6 to 2P E6. The results of the logistic regression serve as the basis for the quality screen, targeting Staff Sergeants most likely to be 2P. Although the logistic regression has a misclassification rate of 33 percent, the Type I error for identifying the most likely 2P Staff Sergeants is only 27 percent for the selected quality screen level of 20 percent.

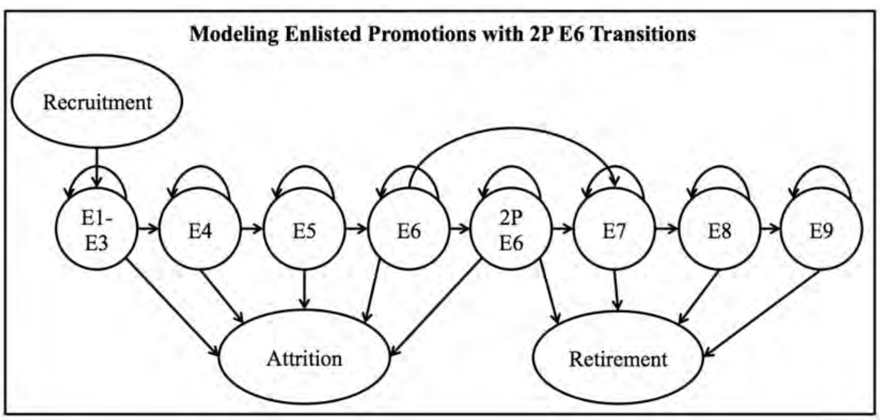

Figure 1. *Markov Model For Marine Corps Enlisted Promotions with 2P E6 Transitions*.

Implementation of the base-case, quality screen, and non-retention policies in the Markov model provides a comparison of annual promotion rates as a percent of the total inventory for that grade, and average time in grade for each rank, as shown in Figure 2. There is a slight increase in the promotion rate for E1 through E5 as the number of 2P E6 in the system is reduced. The largest decrease in average time in grade is for Staff Sergeants, which is reduced from 4.4 years in the base case to 4.0 years for the quality screen and 3.8 years for the non-retention policy.

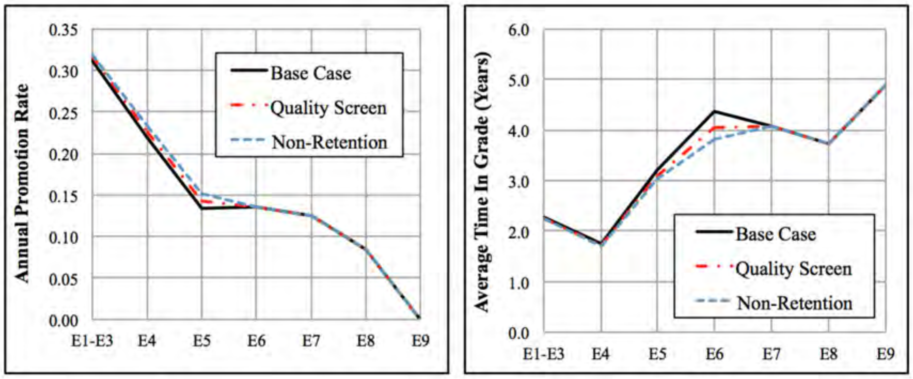

Figure 2. *Annual Promotion Rates (left) and Average Time in Grade (right) by Grade.*

A comparison of steady-state inventories from the three policy alternatives reveals a reduction in 2P E6 inventory, while maintaining the target inventory of total Staff Sergeants, as shown in Figure 3. A 20-percent quality screen reduces 2P Staff Sergeant inventory by 9.4 percent and a non-retention policy reduces 2P Staff Sergeant inventory by 59.7 percent. Assuming a 6-percent discount rate, the present value of retirement obligations due to 2P Staff Sergeant retention are conservatively modeled as fixed income annuities, where a quality screen has a proportional reduction in retirement obligations to the reduction in 2P Staff Sergeants, from $122 million to $110 million. A non-retention policy incurs no retirement obligations.

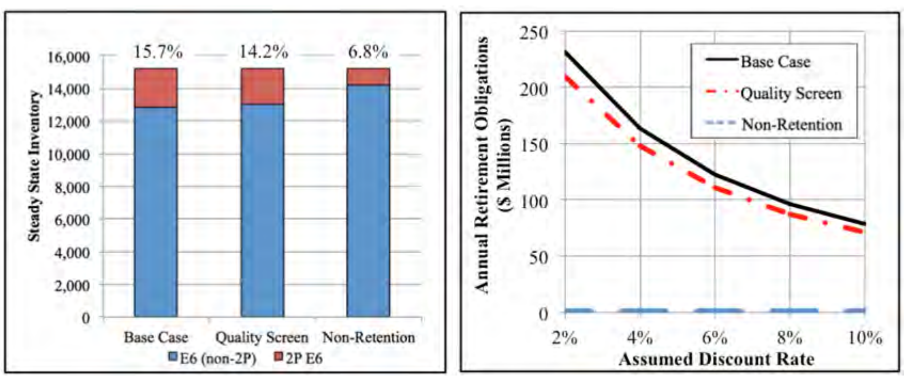

Figure 3. *Steady-State Inventory of Staff Sergeants with 2P E6 Proportion (left) and Present Value of Annual Retirement Obligations Incurred by Assumed Discount Rate (right).*

In addition to retirement obligations, retention of 2P Staff Sergeants carries an institutional cost in terms of productivity loss. This analysis estimates productivity loss by simulating variation in Staff Sergeant leadership effect, which is a supervisor's impact on unit performance or productivity. Assuming that both 2P and non-2P Staff Sergeants supervise the same number of Marines in grades E1–E5, the average number of Staff Sergeant subordinates is 8.7 Marines. The average Staff Sergeant is assumed to get 40 man-hours of weekly productivity from each member of his or her team, which is a total of 388 man-hours of productivity, including the Staff Sergeant. A sensitivity analysis of the standard deviation of leadership effect, from 5 to 25 percent, is shown in Figure 4. Assuming a 15-percent standard deviation and below-average performance of 2P Staff Sergeants, 2,770 full-time equivalents (FTEs) are lost each year due to 2P retention. Productivity loss is reduced to 2,510 or 1,120 FTEs for a quality screen or non-retention policy, respectively.

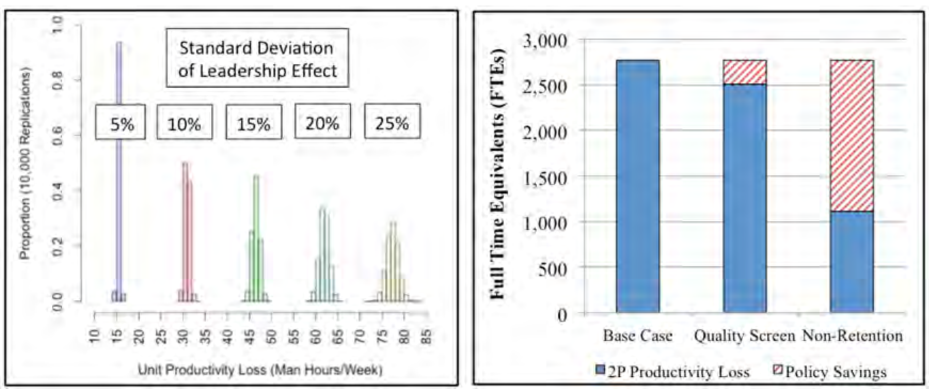

Figure 4. *Sensitivity Analysis of Leadership Effect Standard Deviation (left) and Estimated Productivity Loss for 2P Staff Sergeant Teams with Below-Average Performance and 15% Standard Deviation in Leadership Effect (right).*

There is also an institution cost in excess subordinate attrition resulting from 2P Staff Sergeant retention. Excess attrition is simulated as a function of individual turnover hazard, which is the probability of subordinate attrition under a specific supervisor. A sensitivity analysis of the standard deviation of turnover hazard, from 5 to 15 percent, is shown in Figure 5. Assuming the same team size, a 10-percent standard deviation, and below-average performance of 2P Staff Sergeants, there is excess attrition of 340 Marine subordinates each year due to 2P Staff Sergeant retention. Excess attrition is reduced to 310 Marines or 140 Marines for the quality screen and non-retention policy, respectively.

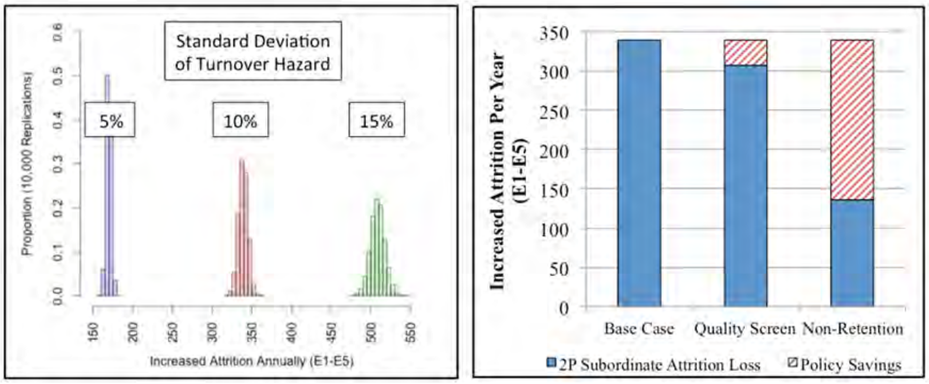

Figure 5. *Sensitivity Analysis of Turnover Hazard Standard Deviation (left) and Excess Subordinate Attrition for 2P Staff Sergeant Teams with Below-Average Performance and 15% Standard Deviation in Turnover Hazard (right).*

Given the institutional costs of productivity loss, excess subordinate attrition, and retirement obligations, it is clear that considerations for 2P Staff Sergeant retention should address more than the impact on the individual Marine; however, the most significant limitation to this argument is the lack of research surrounding the leadership effects and turnover hazards within the Marine Corps. In the base case, a 2P Staff Sergeant inventory of 2,384 results in estimated productivity losses of 2,770 $\pm$ 50 FTEs, excess subordinate attrition of 339 $\pm$ 6 Marines, and retirement obligations with a present value of \$122.3 $\pm$ \$0.2 million on an annual basis. The estimated institutional costs associated with each policy alternative are shown in Table 2.

Table 2. *Estimated Institutional Costs Incurred Annually Due to 2P Staff Sergeant Retention.*

	2P Staff Sergeant Inventory	Retirement Obligations	Lost Productivity	Excess Attrition
Base Case	2,380	\$120 M	2,770 FTEs	340 Marines
20% Quality Screen	2,160	\$110 M	2,510 FTEs	310 Marines
Non-Retention	960	\$ 0 M	1,120 FTEs	140 Marines

These results provide an order of magnitude estimate of the institutional costs associated with the retention of 2P Staff Sergeants. Although these estimates are simulated using a number of assumptions, they represent potentially significant recurring costs that can be reduced through the use of identified retention policies. The results of this study also show that targeted retention policies can have a direct impact on improving promotion tempo and should supplement current promotion policies as a means of ensuring quality in the enlisted force.

ACKNOWLEDGMENTS

I would like to thank all of those at M&RA who assisted me throughout this process. The historical review would never have come together without the fastidious record keeping of Lane Beindorf at MPP-20. His institutional knowledge and assistance also contributed to completion of the analysis by providing historical promotion and inventory data. Tim Johnson provided tremendous support from the TFDW Service Desk. His responsiveness and flexibility when working with me to identify necessary records were more than I could have asked for. Captain Chase Bradford and Gunnery Sergeant Abraham Gonzalez at MMEA-1 were instrumental both in terms of explaining reenlistment procedures and providing reenlistment data, which formed the basis of the exploration.

I also have to thank my NPS mentors and colleagues for all of the support I received. My advisor, Samuel Buttrey, and second reader, Major Chad Seagren, both provided valuable guidance and feedback regarding completion of this thesis. They entertained my approach and provided the freedom for me to chart my own path. Kerry Hogan, Abbie Merkl, Abaigeal Pacholk, and John Sprague were my family away from home over the last two years, and they suffered my musings more than most. I owe Abbie, in particular, more than can be repaid for her contributions and edits.

I promised Adam that his name would make publication, so this goes out to each of my siblings, Adam, Emily, Sarah, and Andrew, as well as my parents Tami and Dave. I blame both my procrastination and my desire for perfection on my mother, and I would have it no other way. Finally, to Alex, thank you for your willingness to help me formulate my thoughts into concrete ideas and for your tireless love and support.

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I. INTRODUCTION

In the Marine Corps, the term twice-passed (2P) refers to a Marine who has been eligible for and failed selection to the next higher rank on two or more occasions. In the Marine Corps, retention of 2P Staff Sergeants lowers the quality of the enlisted force, slows promotion rates, and has a potentially significant institutional cost. The Marine Corps traditionally "keeps faith" with Marines by allowing them to complete twenty years of service and receive a full retirement, as long as they reach the rank of Staff Sergeant. The high year of tenure (HYT) for Staff Sergeants is twenty years regardless of the number of times they are passed for promotion (Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20), 2014b). The retention of Staff Sergeants following their second pass for promotion has been a contentious issue for the last 30 years, with the debate involving members of the Marine Corps, Navy, and Congress. This debate focuses primarily on the impact to the individual Marine and the potential impact on promotion rates, but fails to address the greater institutional cost of retaining these Marines.

Analysis of data from MPP-20 reveals that, on average, almost 16 percent of the total Staff Sergeant inventory has been passed twice for promotion to Gunnery Sergeant. Data from Defense Manpower Data Center (DMDC) shows that most Staff Sergeants receive their second opportunity for promotion prior to 13.5 years of service, but this can happen even earlier than the tenth year of service. The result is a group of non-competitive Staff Sergeants who may remain in the force for as many as ten additional years with limited potential for advancement. The retention process, by which a Marine must apply for reenlistment approximately every four years, is an underutilized opportunity to identify Marines with limited potential for future service. Marines usually reach their third reenlistment between ten and fourteen years of service. During each fiscal year, these Marines make up the Zone C reenlistment cohort (MPP-20, 2014c). This reenlistment period provides an opportunity to evaluate performance and potential for future success.

A. OBJECTIVES AND METHODOLOGY

The objectives of this study are to determine predictors of 2P likelihood, evaluate the efficacy of retention policy alternatives, and investigate institutional costs of retaining 2P Staff Sergeants in terms of productivity loss, excess subordinate attrition, and retirement obligations. In order to determine predictors of 2P likelihood, this study uses logistic regression with a response variable where success is defined as promotion to Gunnery Sergeant and failure is defined as two passes for promotion to Gunnery Sergeant. The independent variables include both demographic and performance data from the Total Force Data Warehouse (TFDW) and Total Force Retention System (TFRS). The population for the logistic regression is established by the Fiscal Year 2007 (FY07) through FY11 Zone C reenlistment cohorts. The cohorts are chosen such that Marines still on active duty have approximately 15–20 years time in service (TIS), enough time in most cases to have been eligible for the Gunnery Sergeant promotion board twice. The ability to predict 2P likelihood allows the implementation of an effective quality screen during the reenlistment process, reducing the number of future 2P Staff Sergeants, and improving the overall quality of the force.

In order to evaluate the efficacy of policy alternatives, this study uses Markov models to simulate the impact of each policy on the enlisted inventory and promotion system. The policy alternatives include the base-case, quality screen at reenlistment, and non-retention policies for 2P Staff Sergeants. The base-case models existing policy conditions, the quality screen models a decrease in approved Zone C reenlistments, and the non-retention policy models the separation of 2P Staff Sergeants following their second pass for promotion. This analysis uses optimization to determine the necessary steady-state recruitment and promotion rates to meet future Marine Corps target inventories, based on historic wastage rates. The sources of data used for this analysis are DMDC and MPP-20. This analysis evaluates policy impacts on promotion rates, average time in grade (TIG), and the inventory of 2P Staff Sergeants.

In order to investigate the institutional costs associated with 2P Staff Sergeant retention, this study develops a framework for considering productivity loss, excess subordinate attrition, and retirement obligations. This framework relies on results from existing literature that reveal leadership effects, which are a measure of supervisor impact on team performance or productivity, and turnover hazard, which is a measure of supervisor impact on attrition, for various industries. Retirement obligations are estimated using a fixed-income annuity model. These results provide an order of magnitude estimate of the institutional costs associated with the retention of 2P Staff Sergeants.

B. ASSUMPTIONS AND LIMITATIONS

The most basic assumption of this study is that the promotion process is efficient and promotes the best and most highly qualified Marines at each rank and that promotion to Gunnery Sergeant is a valid measure of success for a Staff Sergeant. Some Marines, particularly those who have been passed for promotion, may challenge this assumption, but evaluating the efficacy of the Marine Corps promotion process is outside the scope of this research. Given an efficient promotion process, it is reasonable to assume that a Marine who is passed over twice for promotion has below-average performance or worse. This analysis assumes the quality, or performance, of individuals within the inventory of Staff Sergeants is normally distributed. This means an average Marine is retained at fair value, above-average Marines are retained at a discount, and below-average Marines are overvalued. Each portion of this analysis requires additional assumptions, which are addressed as necessary.

The most significant limitation of the study is that the true impact of Staff Sergeants on unit productivity and attrition within the Marine Corps is unknown, which makes it difficult to evaluate the institutional costs. The use of results from existing literature and sensitivity analysis address this limitation. In addition, some performance data is unavailable for this analysis, specifically fitness report data. The lack of fitness report data makes an evaluation of performance more difficult; however, other performance indicators are used to provide relevant results. Available reenlistment data consists only of approved reenlistments, so it is not possible to determine the current level of selectivity during the reenlistment process. Other limitations are addressed throughout this report.

C. COURSE OF STUDY

This thesis consists of eight chapters. Chapter I, Introduction, provides an introduction to the thesis, including an overview of the problem statement, objectives, scope, and key assumptions and limitations for the analysis. Chapter II, Background, considers the historical debate surrounding the retention of 2P Staff Sergeants, current Enlisted Career Force Control (ECFC) policies, and existing literature. The historical account reveals that the retention of 2P Staff Sergeants has been a contentious issue within the Marine Corps, Navy, and Congress for thirty years. Consideration of ECFC policies establishes the current state of the Marine Corps retention and promotion systems. Relevant literature regarding predictors of performance, inventory management within hierarchical organizations, and the impact of managers on organizational success is also considered.

The objective of Chapter III, Regression: Indicators of Performance, and Chapter IV, Regression: Twice-Passed Likelihood, is to determine predictors of 2P likelihood for Staff Sergeants at the time of Zone C reenlistment using logistic regression. Chapter III introduces the data, methodology, and regressors used in the logistic regression. A univariate analysis of each regressor provides the basis for using these variables as indicators of performance. Chapter IV addresses model selection, results, and validation for the logistic regression. The error rate established by the regression results is used in the subsequent chapters as an estimate of the error rate for a quality screen.

The objective of Chapter V, Markov Models: Enlisted Promotion, and Chapter VI, Markov Models: Policy Alternatives, is to evaluate the efficacy of retention policy alternatives and their impact on the promotion system using Markov models and optimization. Chapter V introduces the enlisted promotion Markov model, which includes a 2P Staff Sergeant state for evaluation of retention policies. The base case for policy comparison is established using historical transition rates and optimization. Chapter VI extends the model to quality screen and non-retention policies to compare the impact of these policies on the enlisted promotion system.

The objective of Chapter VII, Simulation: Institutional Costs of 2P Retention, is to develop a framework for estimating the institutional costs of retaining 2P Staff Sergeants. Productivity loss, excess subordinate attrition, and retirement obligations are the three types of institutional cost considered. Chapter VIII, Conclusions and Recommendations, highlights the conclusions of the study, makes recommendations for retention policy, and suggests future work to expand on the concepts addressed within this thesis.

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II. BACKGROUND

In order to address the need for better 2P Staff Sergeant retention policy, it is necessary to understand the problem through a history of Marine Corps force-shaping policies, a review of current policies, and a discussion of existing literature. The retention of 2P Staff Sergeants has been a contentious issue for more than 30 years and continues to be part of the larger debate regarding manpower policy. As General Joseph F. Dunford (2015) outlines in his 36th Commandant's Planning Guidance:

> We will make the hard calls and embrace change to our long-standing manpower and force structure policies and processes. In this, and in all other areas, we will emphasize quality and capability; where necessary, accept risk in capacity. Accepting risk in capacity means that we will only man structure when we can provide proper leadership. **The end state is to provide the continuity and quality of leadership and the appropriate leader-to-led ratio needed to sustain the transformation and enhance our combat effectiveness through personnel stability** [emphasis in original]. (p. 7)

A. HISTORICAL PERSPECTIVE

After transitioning to an all-volunteer force in 1973, all the armed services struggled with managing their personnel inventory. The Marine Corps began the ECFC program in 1985 to formalize this process for enlisted Marines and continues to manage enlisted end strength through various force-shaping tools under this umbrella (MPP-20, 1991). In order to fully understand the debate and implications surrounding the retention of 2P Staff Sergeants, this historical account outlines the implementation of early ECFC policies, the attempt to expand these policies to 2P Staff Sergeants, and the use of force-shaping measures during the most recent force drawdown. Archived documents from MPP-20 provide the foundation of this history.

1. Shaping the Enlisted Force

The ECFC program is a collection of policies to shape the enlisted force of the Marine Corps. Initially, these policies included evaluating Marines for promotions by Military Occupational Specialty (MOS), shaping of the MOS grade structures, and limiting changes to the Table of Organization (MPP-20, 1991). Additional ECFC policies followed in the late 1980s, including lateral moves for first-term reenlistees, limitations to prior-service accessions, adjustment of HYT limits, and voluntary and involuntary early retirement programs (MPP-20, 1991). Commanders who felt their units lacked the appropriate mix of grade and skill sets, as well as Marines who had left the service due to a perceived lack of promotion opportunities, were the driving force behind these policies. These concerns continue to be pertinent to force-shaping policies today.

The goal of ECFC was to shape the inventory to a target requirement while achieving target promotion rates. This would provide commanders with the appropriate ranks and skill sets, standardize the experience level at each grade, and afford comparable promotion opportunities across all MOS; however, an MPP-20 (1991) assessment of the ECFC found that the existing policies were insufficient to achieve these objectives. The assessment identified that the Marine Corps was experiencing slowing promotion rates and an increase in longevity at most ranks. For example, the proportion of Staff Sergeants with more than twelve years TIS increased from 24 percent at the end of FY85 to 56 percent at the end of FY90 (MPP-20, 1991). This led to a conclusion by MPP-20 (1991) that “while grade shaping creates a necessary structural condition under which standardized promotion tempo can occur, it does not create sufficient conditions for it to occur” (p. 7).

On 18 November 1991, the Commandant of the Marine Corps, General Carl E. Mundy Jr., approved several “up-or-out” retention policies: the separation of Marines at their end of active service (EAS) for 2P Sergeants, 2P Gunnery Sergeants with over 20 years of service, and 2P First Sergeants or Master Sergeants with over 22 years of service (MPP-20, 1994). The separation of 2P Staff Sergeants was not approved at this time due to a concern of “breaking faith” with enlisted Marines who anticipated the ability to retire as a Staff Sergeant (MPP-20, 1994). Other approved policy changes, aimed at improving the Marine Corps’ ability to shape the enlisted force, included decreasing promotion opportunities by 10 percent for all grades, varying promotion opportunity for fast-promoting and slow-promoting MOS, and establishing a formal “above zone” for Marines who had been previously considered, but not selected on a promotion board

(MPP-20, 1994). By 1994, the implementation of up-or-out policies effectively reduced the average TIS and TIG to promotion for every enlisted rank except Staff Sergeant (MPP-20, 1994). The expansion of up-or-out policies to the Staff Sergeant rank, or a "2P Staff Sergeant Retention Policy," would subsequently become a topic of debate within Department of the Navy, as well as Congress.

2. The Politics of Retention Policy

Changes in key leadership positions, specifically Commandant of the Marine Corps and Assistant Secretary of the Navy for Manpower and Reserve Affairs (M&RA), had a direct impact on the implementation of the 2P Staff Sergeant Retention Policy, as varying personalities and opinions came to define the debate around 2P Staff Sergeants. As Commandant, General Mundy approved a 2P Staff Sergeant Retention Policy in 1994, before his retirement in June 1995. His successor, General Charles C. Krulak, ultimately postponed implementation of this policy in 1996, and the policy was not revisited until after General Krulak's tenure ended in June 1999. In addition to the changes in Commandant, the position of Assistant Secretary of the Navy (M&RA) experienced turnover in October 1994, when Dr. Bernard D. Rostker replaced Mr. Frederick F. Y. Pang. Despite past support from Mr. Pang, Dr. Rostker became vocal in his opposition to the proposal. These personnel changes resulted in a robust debate surrounding appropriate personnel policies.

In 1994, the Marine Corps was still unable to meet its target promotion rate for Staff Sergeants. As a result, MPP-20 (1994) recommended expansion of existing up-or-out policies to include Staff Sergeants, noting, "it is instinctive for us to protect our Marines. Therefore, it seems natural to allow [Staff Sergeants] to retire after [20 years of service]. However, we do not believe that we can protect our Marines if by doing so we hurt our Corps" (p. 4). On 30 June 1994, General Mundy approved a 2P Staff Sergeant Retention Policy, which would separate twice-passed Staff Sergeants at their EAS beginning in 1996 (Christmas, 1994).[1] A two-year delayed implementation would allow

[1] The signed 1994 decision brief, including advantages and disadvantages of the policy, is included in Appendix A.

for Staff Sergeants with more than 16 years of service to be “grandfathered” in by reaching 18 years of service prior to the policy taking effect (Christmas, 1994). Under 10 United States Code § 1176, service members have retirement sanctuary at 18 years, guaranteeing retention for service members within 2 years of retirement eligibility (United States, 1996). Although this policy met the sanctuary requirement of the law, there was a concern about the impact on Staff Sergeants with less than 18 years of service who would be denied further service.

In correspondence informing the Assistant Secretary of the Navy (M&RA) of the approved policy, Lieutenant General George R. Christmas (Deputy Chief of Staff, M&RA for the Marine Corps) expressed his belief that “separating Marines who are not competitive for promotion is the best way to strengthen the quality of our enlisted force” (Christmas, 1994, p. 1). On 7 September 1994, the 2P Staff Sergeant Retention Policy was officially announced, via ALMAR 267/94, with the support of Mr. Pang (Christmas, 1995). However, following the transition to Dr. Rostker as the new Assistant Secretary of the Navy (M&RA) in October 1994, Lieutenant General Christmas was met with increased resistance to the announced policy (Christmas, 1995). In lieu of the 2P Staff Sergeant Retention Policy, Dr. Rostker proposed a continuation board for all enlisted Marines once they reached 14 years of service (Lange, 1996). The disagreement between Dr. Rostker and Lieutenant General Christmas eventually reached an impasse, which would lead to the involvement of the Commandant and Under Secretary of the Navy.

One of Dr. Rostker’s primary concerns regarding the announced 2P Staff Sergeant Retention Policy was the perceived disparate treatment between officer and enlisted personnel of similar TIS, specifically with regard to retirement sanctuary (Lange, 1996). In a memo to Lieutenant General Christmas, Dr. Rostker suggested that Congress and the Department of Defense (DoD) intended a retirement sanctuary of 6 years for both officer and enlisted personnel (Lange, 1996). He referred to DoD Directive Number 1320.08, which, at the time, stated that officers will “normally be selected for continuation” if they are within 6 years of qualifying for retirement (Lange, 1996). Of note, the most recent change to Directive 1320.08, modifies this language to apply only to officers within 4 years of qualifying for retirement, and adding “there is no entitlement to continuation.

Selection or non-selection will be based on the set criteria of the Secretary of the Military Department concerned" (Department of Defense, 2012, p. 4). This change in language reflects a growing understanding that each service must be provided flexibility to manage its personnel inventory. The debate over what constitutes equal treatment for officer and enlisted personnel and the trigger for retirement sanctuary became a recurring theme in discussions regarding the 2P Staff Sergeant Retention Policy.

As full implementation of the policy approached, Congress became more involved in the debate, highlighted by a 1 February 1996 letter from Staff Sergeant Kenneth W. Geheb to the House of Representatives Committee on National Security (now the Committee on Armed Services):

> I was denied re-enlistment and only allowed to extend for eighteen months. This extension will expire when I have seventeen years and eight months of completed service. At that time, I will be involuntarily separated as a direct result of the enclosed [ALMAR 267–94]….
>
> I do not see this as "Taking care of our Own." It is wrong to put Marines like me out on the street at forty years old with no job skills, other than that of an infantryman, no pension, and worst of all, the feeling of inadequacy that goes along with being forced out of a service that I have dedicated my life. (Dornan, 1996, Encl 1, p. 1)

On 13 February 1996, Representative Robert K. Dornan (Chairman of the Military Personnel Subcommittee) addressed Staff Sergeant Geheb's concerns in a letter to the Commandant, General Krulak (Dornan, 1996). Representative Dornan relayed Staff Sergeant Geheb's letter and expressed his own doubts about the efficacy of the 2P Staff Sergeant Retention Policy. He addressed retirement sanctuary, echoing Dr. Rostker, stating "all the services have maintained over the years, and the Congress has subsequently internalized, the principle that the armed forces must avoid betraying the loyalty of members who have served more than [15] years," and "the Marine Corps will be the only service to force enlisted members out of the military with 14–16 years of service" (Dornan, 1996, p. 1).

At the request of Congress and the Department of the Navy, the Marine Corps evaluated several alternatives to the 2P Staff Sergeant Retention Policy without an acceptable solution. Facing external pressure, General Krulak halted full implementation of the policy in an e-mail to Lieutenant General Christmas on 19 March 1996:

> Everyone that I have met with on the Hill … from Dornan to Coats[2] … all are "in arms" over the policy … not because of the 2-P but because it is not "equal treatment" for both officer and enlisted. They have a good point. I want to put a hold on this policy pending a review by you, me, your guys and [Sergeant Major Lewis G.] Lee. (Krulak, 1996, pp. 1–2)

On 19 April 1996, the 2P Staff Sergeant Retention Policy was formally suspended in ALMAR 163/96 in order to "examine options to lessen the impact this policy would have on Marines with more than [14] years of service" (MPP-20, 1996, p. 1). Following General Krulak's retirement 3 years later, MPP-20 renewed its effort to implement an effective 2P Staff Sergeant Retention Policy.

A 1999 draft proposal of a 2P Staff Sergeant Retention Policy would have grandfathered all existing Staff Sergeants, regardless of TIS; only newly promoted Staff Sergeants would be subject to separation if passed twice for Gunnery Sergeant (MPP-20, 1999). In a memo to Lieutenant General Jack W. Klimp (Deputy Chief of Staff of M&RA), Sergeant Major Mark Ouellette (Sergeant Major of M&RA) expressed the support of senior enlisted Marines for the proposal; "At the [Sergeant Major of the Marine Corps] Symposium, <u>all</u> said '2P [Staff Sergeants] should be separated if they have not reached [18 years of service]' [emphasis in original]" (Ouellette, 1999, p. 2). The proposal was submitted to staff sections for comment and received a mixed response. In staffing comments, there was a specific recommendation to screen Marines more closely at the time of reenlistment as a means to reduce the number who would be twice-passed (MPP-20, 1999). Despite widespread support within the Marine Corps senior enlisted population, the 1999 proposal was not implemented.[3]

[2] Senator Daniel R. Coats was a member of the Subcommittee on Personnel in the Senate Committee on Armed Services.

[3] For additional insight into the discourse surrounding this policy, refer to Appendix B, Archived Correspondence Regarding 2P Staff Sergeant Retention Policy (1994–1999).

3. Keeping Faith During a Force Drawdown

In 2007, the Marine Corps began increasing end strength with a target of 202,000 Marines (Cole, 2014). By FY13, the Marine Corps reversed course and began a force drawdown toward post-conflict end strength targets, a reduction of 20,000–30,000 Marines. In order to meet the drawdown requirements, the Marine Corps instituted two temporary programs with the aim of reducing the size of the force through voluntary separation, Voluntary Separation Pay (VSP) and Temporary Early Retirement Authority (TERA). These programs were targeted at Marines in over-populated MOS, providing separations pay for voluntary separations and retirement eligibility for Marines with more than 15 years of service in eligible MOS. The voluntary separation programs were limited in scope and provided only one fiscal year to realize results.

By 2014, "voluntary separation programs [had] not resulted in sufficient losses to maintain a healthy opportunity for timely promotion," prompting the first Staff Sergeant Retention Board announced in MARADMIN 242/14 (MPP-20, 2014a, p. 1). As a result of the board, 2P Staff Sergeants between 15 and 18 years of service not selected for retention were denied further service beyond 1 January 2015, and given the opportunity to apply for TERA (MPP-20, 2014a). The FY14 board considered 798 Staff Sergeants for retention and chose not to retain 233, or about 29 percent, of those eligible (Sanborn, 2014). Marines selected for retention by the FY14 board are not subject to subsequent retention boards, one of which is planned for FY15 (MPP-20, 2014a). The FY14 Staff Sergeant Retention Board was the first successful implementation of a 2P Staff Sergeant Retention Policy, made less divisive, in part, due to the availability of TERA. However, this is a temporary board, along with TERA and VSP, which does not address retention of 2P Staff Sergeants in the long term. Effective ECFC policies are needed to manage the 2P Staff Sergeant population in a consistent manner, regardless of increases and decreases to force levels.

B. ENLISTED CAREER FORCE CONTROLS

The Marine Corps' use of ECFC to shape the enlisted force has continued to evolve since these policies were formalized in 1985. Each year, Marine Corps Bulletin

5314 specifies the individual ECFC policies in effect for that year. For 2015, ECFC policies include enlisted grade structure reviews, restrictions on prior service accessions, First Term Alignment Plan (FTAP), Subsequent Term Alignment Plan (STAP), promotion selection by primary MOS, variable selection opportunity, control of meritorious promotions, and service limits (MPP-20, 2014b). The STAP, service limits, variable selection opportunity policies have a direct impact on the inventory of 2P Staff Sergeants.

1. Subsequent Term Alignment Plan

STAP establishes reenlistment goals within each MOS for career Marines, who are Marines beyond their initial contract. “The purpose of the STAP is to retain enlisted career Marines with proven performance and demonstrated potential to meet the operational requirements of the Marine Corps” (MMEA, 2014, p. 1). Marines applying for reenlistment are placed in cohorts, or zones, based on projected TIS at their pre-reenlistment EAS. A Zone C reenlistment cohort consists of Marines who will have 10 to 14 years of service when they reach their current EAS (MPP-20, 2014c). With a standard term of enlistment being 4 years, this is approximately the third time that a Marine is applying for reenlistment.

Due to current service limits for Sergeants, a Zone C Marine has likely reached the rank of Staff Sergeant prior to applying for reenlistment. While reenlistment of career Marines has traditionally been viewed as a “disapprove by exception” process, this is an opportunity to screen the quality of the force and shape the inventory of personnel, which MPP-20 (1991) acknowledges:

> We should ensure that a distinction is made between a continuation decision (reenlistment) and a career progression decision (promotion). The reenlistment process makes a decision of “qualified” or “not qualified” to remain in the force. The reenlistment process should, however, continue to be a point at which we check force quality. (pp. 16–17)

A stronger quality screen at the time of Zone C reenlistment, as opposed to merely describing a Marine as “qualified,” allows for the potential reduction in the population of 2P Staff Sergeants prior to 14 years TIS. This avoids the contentious issue of whether sanctuary in intended to take effect at the 14- or 18-year mark, which has been controversial throughout the history of the 2P Staff Sergeant Retention Policy.

2. Service Limits

Current service limits require Marines to separate from active service, or transfer to the Fleet Marine Corps Reserve, once they reach HYT without promotion to the next grade. These service limits include additional stipulations for 2P Marines at each rank, with the exception of Staff Sergeant; the HYT for Staff Sergeants is 20 years regardless of whether they have been twice passed for promotion (MPP-20, 2014b). This discrepancy reflects the lack of a permanent 2P Staff Sergeant Retention Policy and highlights the difference in policies regarding 2P Staff Sergeants and Marines twice passed for promotion at other ranks. Staff Sergeant is the only rank that does not further limit the HYT for 2P Marines, as shown in Table 1.

Table 1. *2015 Enlisted Promotion Targets and High Year of Tenure Limits*. HYT for 2P Marines are earlier than regular HYT limits for each rank except Staff Sergeant (after MPP-20, 2014b).

Rank (Grade)	**Target TIS to Promotion (Years)**	**HYT Limit (Years)**	**2P Marine HYT Limit (Years)**
Sergeant (E5)	4.0	10	EAS
Staff Sergeant (E6)	8.5	20	20
Gunnery Sergeant (E7)	13.0	22	20 / Serve to EAS
Master Sergeant / First Sergeant (E8)	17.5	27	22 / Serve to EAS
Master Gunnery Sergeant / Sergeant Major (E9)	22.0	30	N/A

3. Variable Selection Opportunity

Each year, Marine Corps Bulletin 1430 establishes the eligible population for selection to the next rank and defines promotion zones for each MOS, including the above zone. The above zone consists of Marines who have been previously considered for promotion but not selected, including all eligible 2P Marines. For Marines who have not been previously considered for promotion, the number placed in the promotion zone, or "in zone," is determined by available promotion allocations and the MOS selection opportunity. Selection opportunity is the prescribed ratio of promotion allocations to the number of Marines placed in zone. The number of above-zone Marines within an MOS is not considered when establishing selection opportunity.

Selection opportunity is varied depending on whether an MOS meets the target TIS to promotion and is used as a method to standardize promotion tempo for fast and slow-promoting MOS; the target TIS to promotion for Staff Sergeants is 8.5 ± 1 years (MPP-20, 2014b). A lower selection opportunity for slow-promoting MOS increases the number of Marines placed in zone per promotion allocation, as shown in Table 2. This has the effect of increasing the rate at which Marines are considered for promotion in slow-promoting MOS (MPP-20, 2014b). An indirect consequence of a decrease in promotion opportunity is that an increased percentage of in-zone Marines will receive their first pass for promotion. For Staff Sergeants in slow-promoting MOS, at least 35 percent of in-zone Marines will receive their first pass instead of the standard 25 percent. This makes promotion boards for slow-promoting MOS more competitive and increases the number of Marines in the above zone for subsequent boards.

Table 2. *2015 Staff Sergeant Variable Selection Opportunity for Promotion to Gunnery Sergeant*. A standard selection opportunity is 75 percent, meaning 1.33 Marines are placed in the promotion zone for each promotion allocation and at least 25 percent of in-zone Marines will be passed once. For slow-promoting MOS, at least 35 percent of in-zone Marines will receive their first pass for promotion (after MPP-20, 2014b).

	Average TIS to Promotion (Years)	**Selection Opportunity**	**Placed In Zone Per Allocation**	**Minimum Passed for Promotion**
Fast-Promoting	< 7.5	0.85	1.18	15 %
Standard MOS	7.5 - 9.5	0.75	1.33	25 %
Slow-Promoting	> 9.5	0.65	1.54	35 %

The result of the variable selection opportunity policy is an increase in the population of once-passed and twice-passed Marines in slow-promoting MOS. These above-zone Marines are also competing for promotion with those placed in zone, resulting in more competitive boards than the selection opportunity alone would suggest, which does not account for above-zone Marines. Although it seems intuitive to address promotion tempo with promotion policies, in a promote-to-vacancy organization, the appropriate way to standardize promotion tempo may lie in refined retention policies. To continue to improve upon existing policies, the Marine Corps must "embrace change to our long-standing manpower and force structure policies and processes."

C. LITERATURE REVIEW

There is extensive literature surrounding manpower policies and implementation. The ability to understand and predict the effect of policy changes is of interest in every organization. A review of existing literature includes several relevant topics: predictors of performance, inventory management within hierarchical organizations, and the impact of managers on organizational success.

1. Predictors of Performance and Logistic Regression

Indicators of quality may be used as predictors of future performance in the armed services. Although Armed Forces Qualification Test (AFQT) score and high school graduation have been used as traditional indicators of personnel quality, these measures decrease in value as predictors of performance as a service member's career continues (Asch, Romley, & Totten, 2005). Additional indicators of quality have been used to evaluate enlistment, retention, and promotion trends. Examples include rate of promotion to E4, computed reenlistment tiers, commander recommended reenlistment tiers, fitness report data, and performance at military schools; see Asch, Romley, and Totten (2005), Cole (2014), Ergun (2003), Hurst and Manion (1985), and Stoloff (1983). In these studies, indicators of quality are used both to describe and predict process outcomes.

Some of these are aggregate quality measures that are not evaluated for their predictive abilities. The computed reenlistment tier includes Physical Fitness Test (PFT) and Combat Fitness Test (CFT) scores, rifle qualifications, and proficiency and conduct markings and is assumed to be a strong predictor of future performance (Cole, 2014). With a dichotomous response variable, logistic regression can be used to evaluate potential predictors; see Hosmer and Lemeshow (2000) and Whelan (2013). Using twice-passed for promotion as the outcome of interest for Staff Sergeants, quality indicators can be evaluated for their predictive ability. There are a number of measurable quality indicators available at the time of Zone C reenlistment, as discussed in Chapter III.

2. Inventory Management and Markov Models

Markov models provide a useful framework for the consideration of manpower policies and inventory management. Bartholomew (1971) provides the foundational knowledge of using Markov models in organizations where leaving, or "wastage," is a critical aspect of the organization, such as the military. Sales (1971) follows this work by applying Markov models to the Civil Service, which is a hierarchical or "graded" organization, and provides methods for evaluating model validity. Kalamatianou (1987) uses Markov models to evaluate the maintainability of systems with promotion pressure, such as a population of 2P Staff Sergeants:

> High values of pressure would tend to make the system unstable with respect to promotions. A high proportion of unpromoted employees could have a serious effect on the efficiency of the organization for several reasons. For example, a dissatisfied employee may be less efficient and productive because he has lost his interest… or for practical reasons. (pp. 183-184)

Markov models can be extended to Marine Corps manpower planning and are used to predict and optimize accessions, assignments, reenlistments, and promotions; see Licari (2013), Nguyen (1997), Raymond (2006), and Tivnan (1998). Markov models are used in this analysis as a method of comparing manpower policies and their impact on enlisted personnel inventory and promotions.

3. The Impact of Managers on Organizational Success

There is a growing body of literature addressing a manager's impact on the success of an organization, which attempts to quantify the value of, and variation between, managers. Goodall and Pogrebna (2015) focus on the concept of "expert leaders," those with expert knowledge in the core business of their organization. The authors provide a broad review of current research, revealing a range in leadership effects from 4 to 40 percent. Leadership effects are the impact a supervisor has on the performance or productivity of their team. In a study on the productivity of technology-based service workers, Lazear, Shaw, and Stanton (2012) find substantial variation in the impact of supervisors on worker productivity and retention. An average supervisor provides value equivalent to eighteen computer transactions per hour; however, there is a standard deviation of about 4.77 units of output, or 26.5 percent, in the boss effect (pp. 14, 17). In a study using personnel and transaction data from a large Japanese auto dealership, one standard deviation increase in a manager's fixed effects results in a 9.3 percent increase in branch profit (Owan, Takahashi, Tsuru, & Uehara, 2014).

The literature also reveals the difficulty in measuring the value of a manager (Goodall & Pogrebna, 2015). Branch, Hanushek, and Rivkin (2013) estimate the standard deviation of school principal effectiveness through an evaluation of Texas public school data. The authors find standard deviation estimates between 5 and 21 percent with a variety of models using school achievement as the response variable. In most cases, the "worst conceivable boss" is probably not included in a study's sample, meaning an estimate of variance likely represents a lower bound and a truncation of the true underlying distribution (Lazear, Shaw, & Stanton, 2012, p. 16). In addition, productivity is not the only area in which a manager has an impact. One result shows the quality of a supervisor impacts employee retention such that "a boss one standard deviation above the mean quality… experiences a twelve percent reduction in the turnover hazard among her workers" (p. 21).

The value-added of individual Staff Sergeants is not evaluated in this study; however, it is important to understand the potential variability in the impact of a Staff Noncommissioned Officer on his or her subordinates. Staff Sergeants, in particular, have a direct responsibility for Marines placed in their charge. The retention of the lowest performing Staff Sergeants is not just a matter of reduced individual performance, but results in lower performance for the entire team or unit. Without attempting to explicitly evaluate value-added measures for Staff Sergeants, the cost of retaining low performers can be considered using a range of reasonable standard deviations for unit performance, perhaps 5 to 25 percent as evaluated in Chapter VII. This variation in productivity is a driving force behind the desire to identify, and reduce the inventory of, low-performing Staff Noncommissioned Officers.

D. SUMMARY

The retention of 2P Staff Sergeants has been a contentious issue for more than 30 years and continues to be part of the larger debate regarding manpower policy. It is evident that politics and personalities have a large role in this debate the outcome of which has an ongoing impact on the Marine Corps. The Marine Corps uses a number of programs to shape the enlisted force and manage personnel. ECFC policies such as STAP, service limits, and variable selection opportunity have a direct impact on the inventory of 2P Staff Sergeants, but the institutional costs of these policies are not fully understood. A better understanding of predictors of performance, policy alternatives, and the impact of supervisor quality is essential to addressing the future of manpower management. These topics will be addressed in the chapters that follow to provide a framework for investigation and an assessment of the current policy alternatives.

III. REGRESSION: INDICATORS OF PERFORMANCE

The objective of this regression is to determine predictors of 2P likelihood for Staff Sergeants at the time of Zone C reenlistment. Logistic regression is used to evaluate the response variable of interest, twice-passed for promotion to Gunnery Sergeant, as a dichotomous response variable. Equation (1) is the logistic function where $\pi(x_1,...,x_m)$ is the probability a Staff Sergeant will be twice passed for promotion given $x_1,...,x_m$ regressors, Y is the dichotomous response (2P or Not-2P), and $\beta_0,...,\beta_m$ are the coefficients. Equation (2) is the logit function, also known as the log-odds, which relates logistic regression back to a form that is similar to linear regression (Hosmer & Lemeshow, 2000).

$$\pi(x_1,...,x_m) = E(Y \mid x_1,...,x_m) = \frac{e^{\beta_0+\beta_1 x_1+...+\beta_m x_m}}{1+e^{\beta_0+\beta_1 x_1+...+\beta_m x_m}} \tag{1}$$

$$\text{logit}\left[\pi(x_1,...,x_m)\right] = \ln\left[\frac{\pi(x_1,...,x_m)}{1-\pi(x_1,...,x_m)}\right] = \beta_0 + \beta_1 x_1 + ... + \beta_m x_m \tag{2}$$

The ability to predict 2P likelihood allows the implementation of an effective quality screen during the reenlistment process, reducing the number of future 2P Staff Sergeants and improving the overall quality of the force. The data sets used for this analysis are derived from the Total Force TFRS and TFDW. From these data sets, eighteen potential regressors are identified for further analysis, eight of which are included in the final model following univariate and multivariate analysis.

A. DATASETS

The final data set is compiled from two Marine Corps databases, TFRS and TFDW. TFRS data is used to establish the population of interest and provides information from the time of reenlistment. TFDW data is collected for the established population in order to identify 2P Staff Sergeants and supplement the TFRS data. Individual fitness report histories from the Automated Performance Evaluation System (A-PES), which would provide additional 2P indicators, are unavailable at the time of this study. Although this limitation is significant, the data obtained from TFRS and TFDW provide valuable insight into the factors that contribute to a Staff Sergeant being twice-passed.

1. Total Force Retention System

The TFRS database is used by the Marine Corps to process Reenlistment, Extension, and Lateral Move (RELM) requests, and contains archives of prior requests. TFRS data, provided by the Enlisted Retention Section (MMEA-1) at M&RA, includes all Staff Sergeant Zone C reenlistments from FY07 to FY11. This data set consists of 17,736 observations. Each observation represents an approved RELM request and includes the requesting Marine's identification number, fiscal year of reenlistment, pre-reenlistment EAS, Armed Forces Active Duty Base Date (AFADBD), date of rank, MOS, adverse conduct, Commanding General certification, PFT and CFT scores, body composition, racial identification, and commander's reenlistment recommendation. This is a snapshot of the submitted RELM, providing measures of performance for a Marine at the time of reenlistment. Noted absences in the archived TFRS performance data include MCMAP belt attainment, rifle qualification, and pistol qualification.

2. Total Force Data Warehouse

TFDW retains a monthly snapshot of personnel files from the Marine Corps Total Force System. TFDW data, provided by the TFDW Service Desk, includes personnel records for each Marine identified. These records include draw case codes, which are administrative annotations for each individual, including "AT – Marine twice-passed for promotion." 2P Staff Sergeants are identified by evaluating assigned draw case codes from each Marine's time as a Staff Sergeant. The TFDW records also include historical data on individual AFQT scores, awards received, PFT and CFT scores, demographic information, body composition, legal action, MCMAP belt attainment, rifle and pistol qualifications, and promotion data. These records establish the level of the response, 2P or Not-2P, for each observation and supplement the TFRS data.

3. Final Population Sample

Of the 17,736 observations identified as Zone C by TFRS, only 9,212 of these are within 10–14 years of service based on AFADBD and pre-reenlistment EAS. By definition, Zone C reenlistment cohorts only include service members with 10–14 years TIS, so the additional records are excluded from this analysis. Another 905 observations are excluded due to having an indeterminate 2P outcome, meaning it was not possible to determine if the individual is going to be a 2P Staff Sergeant. Only the second RELM approval is considered for individuals with multiple approved RELMs during this period, eliminating another 156 observations. This results in a total of 8,151 individual observations for the final sample, as illustrated in Figure 1.

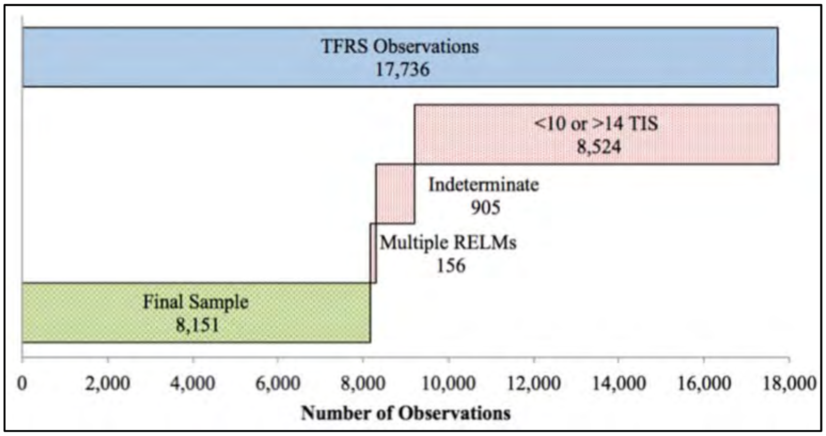


Figure 1. *Reduction of 17,736 Initial Observations to Final Sample Size of 8,151*. An analysis of available TFRS and TFDW data results in a final sample size of 8,151 observations for FY07–FY11 Zone C Staff Sergeant reenlistments.

In the final sample, 40.7 percent of Staff Sergeants are twice-passed for promotion to Gunnery Sergeant. This is not to say that they are never promoted; 32.9 percent of 2P Staff Sergeants in the sample are promoted after they have reached 2P. For this analysis, there is no distinction made for those who are eventually promoted. Staff Sergeants are considered 2P if they are twice-passed for Gunnery Sergeant at any point. The proportion of Staff Sergeants twice-passed by MOS category is shown in Figure 2. MOS categories are specified in Appendix C.

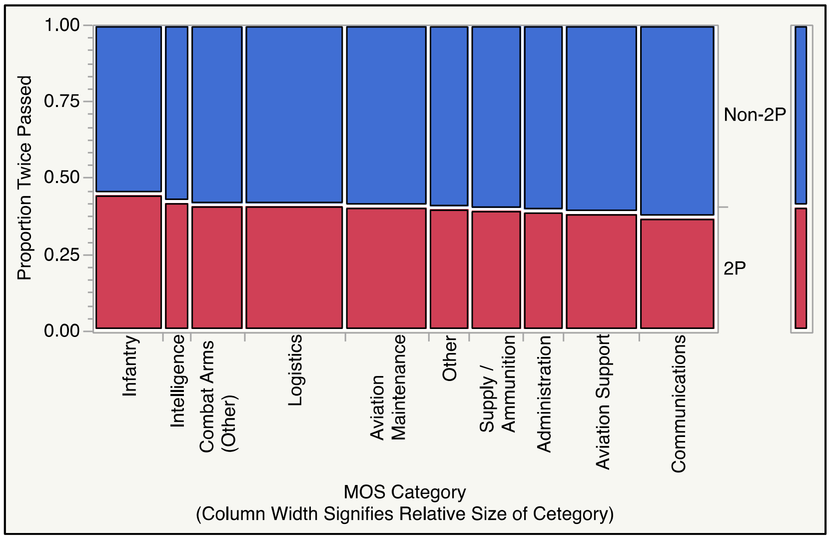


Figure 2. *Proportion of Staff Sergeants Twice-Passed (2P) by MOS Category.* Of the final sample, 40.7 percent are identified as twice-passed. Infantry has the highest proportion of Staff Sergeants twice-passed at 44.9 percent, and Communications has the lowest proportion at 37.5 percent.

B. UNIVARIATE ANALYSIS

In total, eighteen potential variables from the TFRS and TFDW data are considered for inclusion and initially evaluated using univariate regression: AFQT Score (x_{AFQT}), PFT Score (x_{PFT}), Commander's Recommendation (x_{CORec}), MCMAP Belt (x_{MCMAP}), Pistol Qualification (x_{Pistol}), Rifle Qualification (x_{Rifle}), Adverse Material In-Grade ($x_{AdverseInGrade}$), Adverse Material Prior to E6 ($x_{AdversePrior}$), Awarded Bronze Star or Higher Award ($x_{BronzeStarOrGreater}$), Commanding General Certification (x_{CGCert}), Female (x_{Female}), Education Beyond High School ($x_{GreaterThanHS}$), Hispanic Ethnicity ($x_{Hispanic}$), Purple Heart Recipient ($x_{PurpleHeart}$), Outside Maximum Weight by Height (x_{Taped}), Fiscal Year of Reenlistment ($x_{FY(\_)}$), MOS Category ($x_{MOS(\_)}$), and Racial Identification ($x_{Race(\_)}$). Variables shown to be significant during univariate analysis are further considered using multivariate regression techniques. Summary statistics for the eighteen considered variables are shown in Table 3.

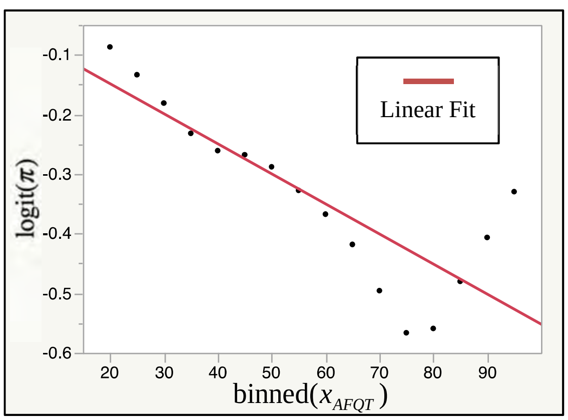
Table 3. *Summary Statistics for Considered Variables*. The selected model includes two continuous variables, two ordinal variables, and four binary variables. Ordinal variables are evaluated as continuous throughout the analysis. Binary variables evaluate to [1] if true and [0] if false; the mean of the binary variables represents the percent true. Nominal variables are coded with a binary dummy variable for each level.

Variable	Final Model	Type	Minimum Value	Maximum Value	Mean	Standard Deviation
x_{AFQT}	X	Continuous	15	99	60	18
x_{PFT}	X	Continuous	110	300	239	33
x_{CORec}	X	Ordinal	1 (Not Recommended)	4 (Recommended w/ Enthusiasm)	3.84	0.41
x_{MCMAP}	X	Ordinal	1 (Unqualified)	6 (Black Belt)	3.62	1.26
x_{Pistol}		Ordinal	1 (Unqualified)	4 (Expert)	3.00	0.81
x_{Rifle}		Ordinal	1 (Unqualified)	4 (Expert)	3.55	0.71
$x_{AdverseInGrade}$	X	Binary	0	1	0.04	0.20
$x_{AdversePrior}$	X	Binary	0	1	0.17	0.37
$x_{BronzeStarOrGreater}$		Binary	0	1	0.03	0.18
x_{CGCert}		Binary	0	1	0.01	0.11
x_{Female}		Binary	0	1	0.06	0.23
$x_{GreaterThanHS}$		Binary	0	1	0.07	0.25
$x_{Hispanic}$		Binary	0	1	0.17	0.38
$x_{PurpleHeart}$		Binary	0	1	0.02	0.14
x_{Taped}	X	Binary	0	1	0.19	0.39
$x_{FY(\_)}$		Nominal	5 Levels		N/A	N/A
$x_{MOS(\_)}$		Nominal	10 Levels		N/A	N/A
$x_{Race(\_)}$	X	Nominal	5 Levels		N/A	N/A

Eight variables are retained following univariate analysis and model selection: x_{AFQT}, x_{PFT}, x_{CORec}, x_{MCMAP}, $x_{AdverseInGrade}$, $x_{AdversePrior}$, x_{Taped}, and $x_{Race(Black)}$. Seven additional variables (x_{Pistol}, x_{Rifle}, x_{CGCert}, x_{Female}, $x_{GreaterThanHS}$, $x_{PurpleHeart}$, and $x_{MOS(\_)}$) are explanatory variables in a univariate analysis, all with p-values less than 0.1. These variables are included during the multivariate analysis; however, they are not significant factors for the final model and are eliminated during the model selection process. The final three variables considered ($x_{FY(\_)}$, $x_{BronzeStarOrGreater}$, and $x_{Hispanic}$) are found to be insignificant during univariate analysis, all with p-values greater than 0.35, and omitted from further analysis. The detailed univariate analysis for the eight selected variables follows. Univariate analysis for the variables not selected is included in Appendix D.

1. AFQT Score

AFQT score, x_{AFQT}, is the result of a standardized test given to each Marine prior to his or her initial enlistment and is a common measure used to evaluate personnel quality. TFDW data provides AFQT scores, and eleven missing values are replaced with the mean score of 60. Initially, an analysis is done to assess whether the logit(π) is linear in x_{AFQT}. AFQT score is binned by five point increments, and the proportion twice-passed (π) is calculated and smoothed using a kernel smoother. The logit of the smoothed π is plotted against binned AFQT scores, shown in Figure 3. Although the relationship looks like it may change for scores higher than 75, only the overall linear relationship is found to be significant during the model selection process. The univariate logistic regression on x_{AFQT} reflects a reduced 2P likelihood as AFQT score increases, also shown in Figure 3.



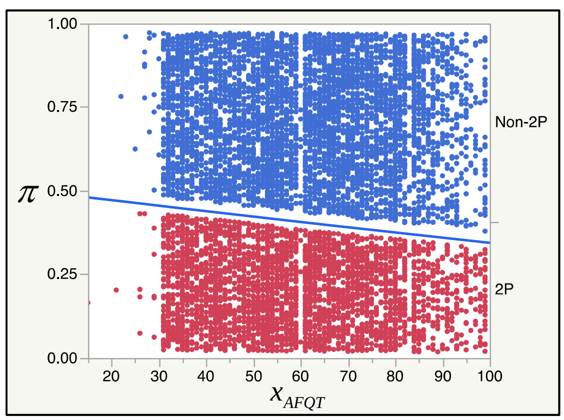
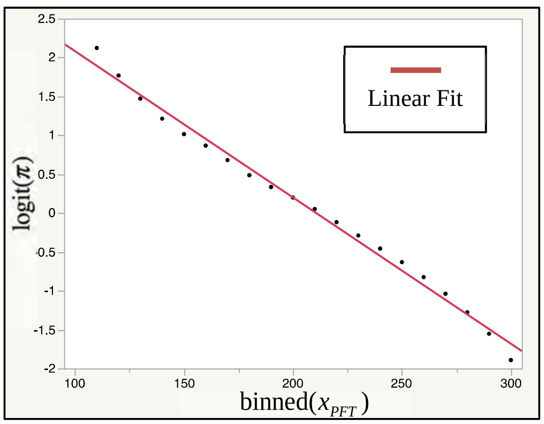


Figure 3. *Log-Odds (left) and Logistic Fit (right) of 2P Staff Sergeants by AFQT Score.* A linear relationship reveals a lower AFQT score is correlated to a higher 2P likelihood (Chi-Squared = 24; p-value < 0.01). The plot of logistic fit includes jittered data points (Red = 2P, Blue = Non-2P) for illustration, but does not represent separable data.

2. PFT Score

PFT score, x_{PFT}, is used as the primary measure of a Marine's physical fitness and is evaluated annually. Although data on CFT scores is now available, the CFT was not implemented until FY08 and was not retained in TFRS until FY11, so it is omitted from the analysis. PFT score is captured at the time of Zone C reenlistment from the TFRS data, and 79 missing values are replaced with the mean value of 239. To determine linearity of logit(π), PFT score is binned by ten-point increments; the proportion twice-passed, π, is calculated and smoothed using a kernel smoother. The logit of the smoothed π is plotted against binned PFT scores, revealing a nearly linear relationship, as shown in Figure 4. The univariate logistic regression on x_{PFT} reflects a reduced 2P likelihood as PFT score increases, also shown in Figure 4.



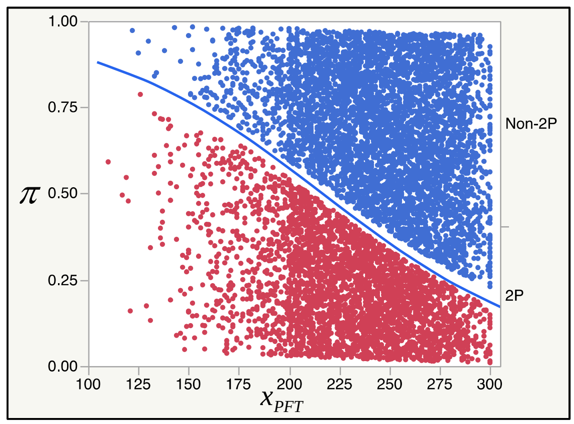


Figure 4. *Log-Odds (left) and Logistic Fit (right) of 2P Staff Sergeants by PFT Score*. A linear relationship reveals a lower Zone C PFT score is correlated to a higher 2P likelihood (Chi-Squared = 621; p-value < 0. 01). The plot of logistic fit includes jittered data points (Red = 2P, Blue = Non-2P) for illustration, but does not represent separable data.

3. Commander's Recommendation

The Commander's Recommendation, x_{CORec}, is a reenlistment recommendation by the Marine's Commanding Officer captured in TFRS at the time of the RELM request. The ordinal variable x_{CORec} consists of four potential levels: 1 - Not Recommended, 2 - Recommended with Reservation, 3 - Recommended with Confidence, and 4 -

Recommended with Enthusiasm. These levels are ordinal where “Not Recommended” is the lowest level, coded as [1], and “Recommended with Enthusiasm” is the highest level, coded as [4]. Any missing values are coded as the mode, 4 – Recommended with Enthusiasm. For the regression, these ordinal levels are evaluated as continuous.

To determine if the linear coding of levels is appropriate, logit(π) is plotted by Commander’s Recommendation level. The π of “Not Recommended” is equal to one, which is undefined in the logit, so the proportion is coded as 0.9999 to approximate an appropriate fit, revealing a reciprocal relationship, as shown in Figure 5. This suggests that a negative Commander’s Recommendation, level [1] or [2], has a much larger impact on the proportion twice-passed than positive recommendations, level [3] or [4]. This likely reflects a commander’s tendency to inflate evaluations for his or her own subordinates, making negative endorsements more significant. This is incorporated into model selection using a reciprocal transformation on the levels of x_{CORec}. The univariate logistic regression on the reciprocal of x_{CORec} shows a reduced 2P likelihood as the recommendation improves, also shown in Figure 5.

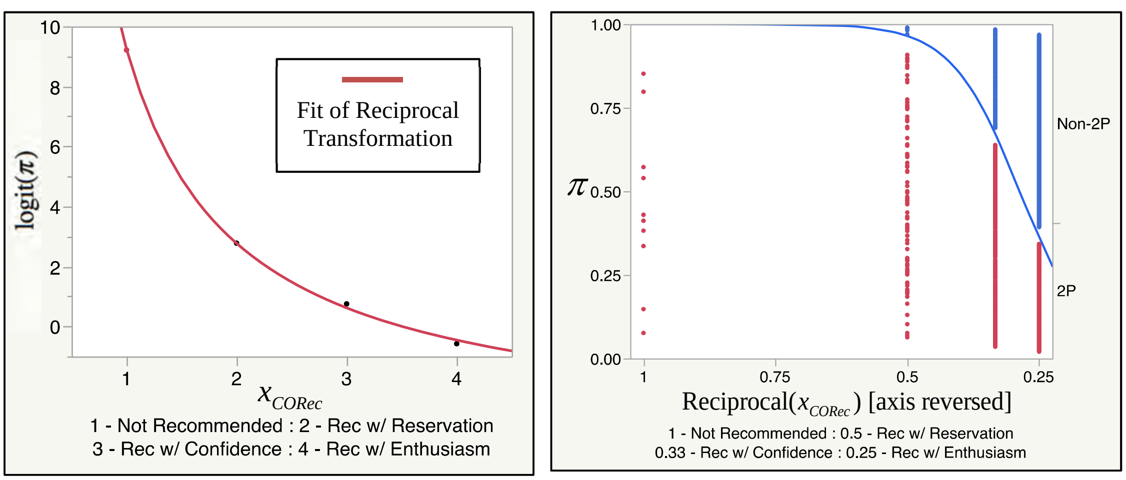


Figure 5. *Log-Odds (left) and Logistic Fit (right) of 2P Staff Sergeants by Commander’s Recommendation.* The plot of log-odds reveals a reciprocal relationship where a lower Zone C Commander’s Recommendation is correlated to a higher 2P likelihood (Chi-Squared = 517; p-value < 0.01). The x-axis of the logistic fit has been reversed to keep lower recommendations on the left hand side of the axis.

4. MCMAP Belt

MCMAP belt qualification, x_{MCMAP}, is not retained within TFRS, so these data fields are pulled from TFDW using the last level obtained prior to a Marine's pre-reenlistment EAS. The ordinal variable x_{MCMAP} has six potential levels: 1 – Unqualified, 2 – Tan Belt, 3 – Grey Belt, 4 – Green Belt, 5 – Brown Belt, and 6 – Black Belt. These levels are coded as ordinal where "Unqualified" is the lowest level, coded as [1], and "Black Belt" is the highest level, coded as [6]. Instructor qualifications are not considered in the analysis. For the regression, these ordinal levels are evaluated as continuous.

To determine if the linear coding of levels is appropriate, logit(π) is plotted by MCMAP belt level, revealing a logarithmic relationship, as shown in Figure 6. This suggests that lower MCMAP belt attainment has a larger impact on the proportion twice-passed than higher belt attainment. This is incorporated into model selection using a logarithmic transformation on x_{MCMAP}. The univariate logistic regression on the natural log of x_{MCMAP} shows a reduced 2P likelihood as the MCMAP level increases, also shown in Figure 6.

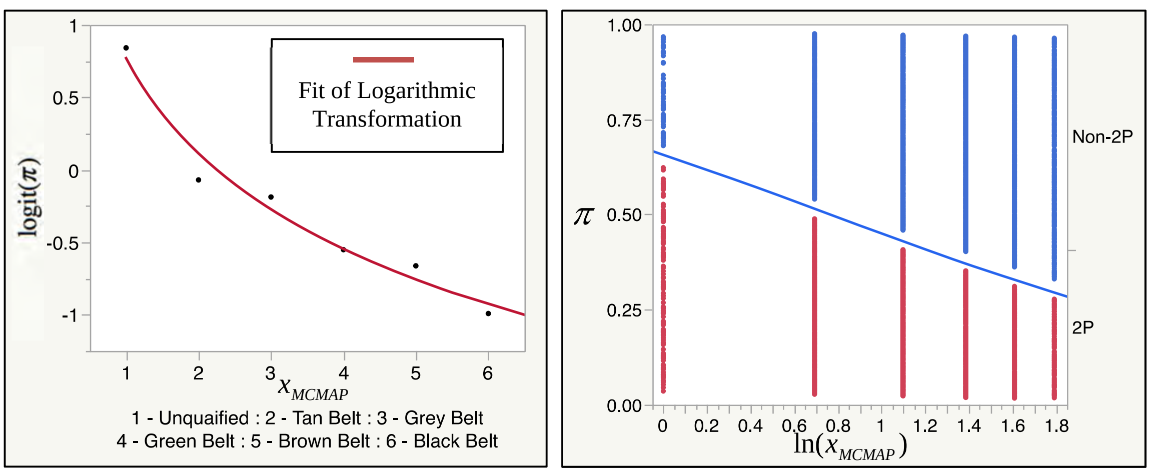


Figure 6. *Log-Odds (left) and Logistic Fit (right) of 2P Staff Sergeants by MCMAP Belt.* The plot of log-odds reveals a logarithmic relationship where lower MCMAP belt attainment is correlated to a higher 2P likelihood (Chi-Squared = 218; p-value < 0.01). The plot of logistic fit includes jittered data points (Red = 2P, Blue = Non-2P) for illustration, but does not represent separable data.

5. Adverse Material (In-Grade and Prior)

Adverse material in-grade, $x_{AdverseInGrade}$, and adverse material prior to the rank of Staff Sergeant, $x_{AdversePrior}$, are binary variables derived from TFDW data. The variable $x_{AdverseInGrade}$ is coded as 1 (True) if the Marine has one or more non-judicial punishments (NJPs), summary courts-martial (SCM), or special courts-marital (SPCM) that occurred after promotion to Staff Sergeant but prior to a Marine's pre-reenlistment EAS. The variable $x_{AdversePrior}$ is coded as 1 (True) if the Marine has one or more NJPs or courts-martial that occurred prior to ae Marine's promotion to Staff Sergeant. Mosaic plots of the proportion of Staff Sergeants twice-passed by $x_{AdverseInGrade}$ and $x_{AdversePrior}$ show that adverse material is associated with a higher proportion twice-passed, as shown in Figure 7.

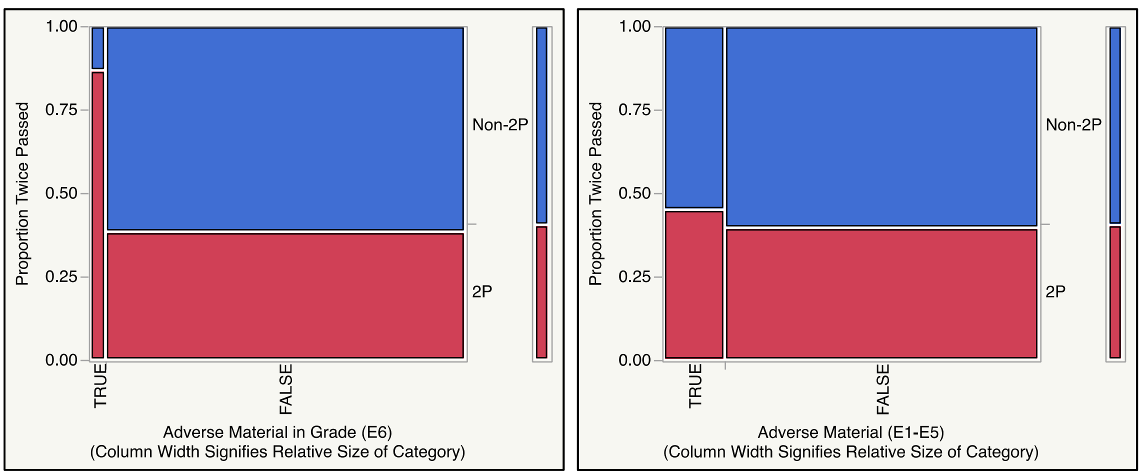


Figure 7. *Mosaic Plot of 2P Staff Sergeants by Adverse Material (NJP, SCM, SPCM) in Grade and Prior (True/False).* A smaller proportion of Zone C Staff Sergeants have adverse material in grade than prior ranks. Adverse material in grade (Likelihood Ratio Chi-Squared = 345; p-value < 0.01) and prior (Likelihood Ratio Chi-Squared = 13; p-value < 0.01) are correlated to a higher proportion of 2P Staff Sergeants.

6. Body Composition

Body composition measurements are conducted at least twice annually. Marines above the maximum weight for their height are measured, or taped, to determine their body fat percentage; Marines within weight standards are not taped. The variable x_{Taped} is a binary variable and coded as 1 (True) if a body fat percentage is reported at Zone C reenlistment in the TFRS data. This does not necessarily mean the Marine is out of standards, as they might be within body fat standards; however, x_{Taped} will be true if any body fat measurement is reported. A mosaic plot of the proportion of Staff Sergeants twice-passed by x_{Taped} shows that being taped is associated with a higher proportion twice-passed, as shown in Figure 8.

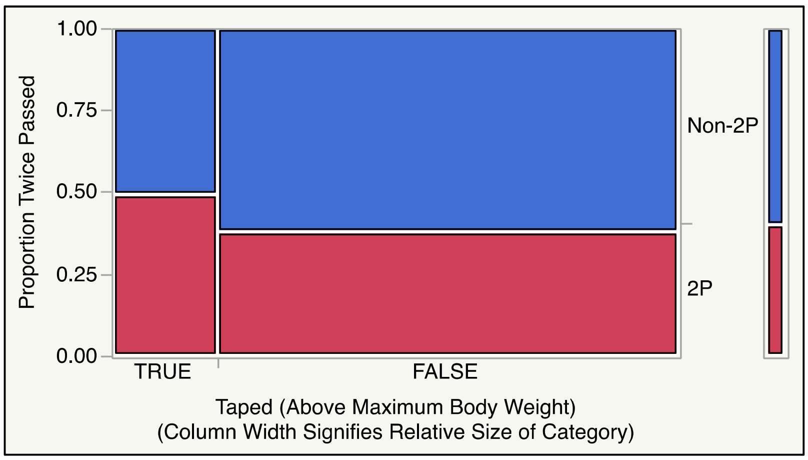


Figure 8. *Mosaic Plot of 2P Staff Sergeants by Taped (True/False)*. Being above maximum body weight by height at the time of Zone C reenlistment correlates to a higher proportion of 2P Staff Sergeants (Likelihood Ratio Chi-Squared = 53, p-value < 0.01).

7. Racial Identifier

Racial identification, $x_{Race(\_)}$, is a nominal variable derived from the TFRS data with five potential levels: Asian, Black, White, Other, and Declined to Respond. Each level is modeled with a binary dummy variable, which is coded as 1 if true. The level Black, $x_{Race(Black)}$, is the only statistically significant level identified during model selection. A mosaic plot of the proportion of Staff Sergeants twice-passed by $x_{Race(\_)}$ shows that Marines identified as black are associated with the highest proportion twice-passed, as shown in Figure 9.

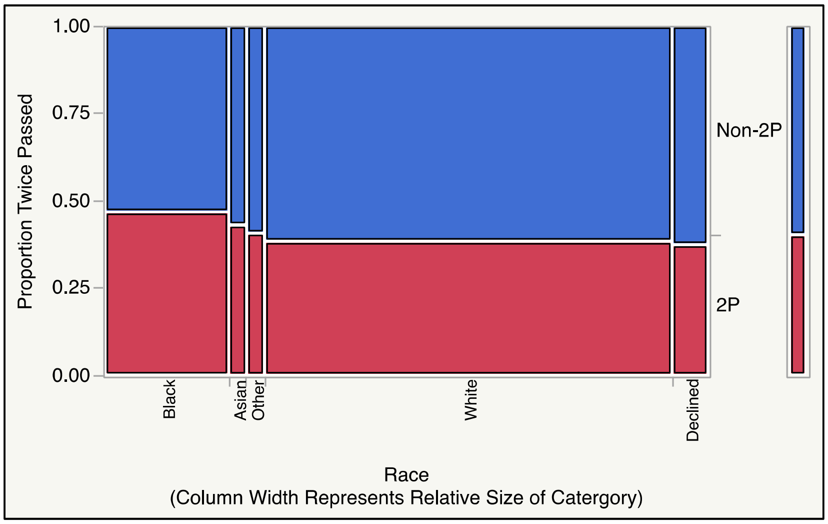


Figure 9. *Mosaic Plot of 2P Staff Sergeants by Racial Identifier.* The subset of black Marines has the highest proportion of 2P Staff Sergeants. (Likelihood Ratio Chi-Squared = 32, p-value < 0.01).

C. SUMMARY

The ability to predict 2P likelihood allows the implementation of an effective quality screen during the reenlistment process, reducing the number of future 2P Staff Sergeants and improving the overall quality of the force. Model selection uses JMP Pro 11 to conduct stepwise logistic regression resulting in eight variables being retained: x_{AFQT}, x_{PFT}, x_{CORec}, x_{MCMAP}, $x_{AdverseInGrade}$, $x_{AdversePrior}$, x_{Taped}, and $x_{Race(Black)}$. Chapter IV shows different selection criteria result in three distinct models: minimum Bayesian Information Criterion (Min-BIC), minimum Akaike Information Criterion (Min-AIC), and all terms with a p-value less than 0.05 (p-value). The Min-BIC and Min-AIC models are found using forward stepwise regression, which selects the variables resulting in a local minimum of BIC and AIC, respectively. The p-value model is found using backward stepwise regression, removing each variable that is not statistically significant to the 0.05 level. Comparison of these models determines the simplest model with adequate performance.

IV. REGRESSION: TWICE-PASSED LIKELIHOOD

The objective is to develop a model that can effectively predict 2P Staff Sergeants at the time of their Zone C reenlistment. This would enable a reduction in the number of 2P Staff Sergeants by using a quality screen prior to a Marine reaching 15 years of service. The logistic regression model selected is the result of a min-BIC stepwise regression, and includes eight of the eighteen variables considered. Of these eight variables, PFT score, commander's recommendation, and adverse material in grade are the most important in terms of response variability. Model validation shows the min-BIC model performs similarly to more complex models when evaluated against a test set. The insights derived from the logistic regression are valuable in evaluating a Marine's quality at the time of Zone C reenlistment.

A. MODEL SELECTION

Within JMP, three potential models are created using stepwise regression: Min-BIC, p-value, and Min-AIC. In comparing the three models, Min-BIC is the simplest model with eight variables and performs similarly to the other models in terms of R^2, AIC, BIC, misclassification rate, and area under the curve (AUC) of the Receiver Operating Characteristic (ROC) curve, as shown in Table 4. As a result, the model from the min-BIC stepwise regression is selected to provide insight into predicting 2P Staff Sergeants. The JMP regression results for all three models are included in Appendix E.

Table 4. *Comparison of Three Logistic Regression Models Using Stepwise Regression*. Min-BIC is the simplest model with eight variables, but has a slightly higher misclassification rate and a slightly lower AUC.

Model	DF	R^2	AIC	BIC	Full Model P-Value	Misclass Rate	AUC
Min-BIC	8	0.143	7,599	7,660	< 0.0001	0.310	0.740
p-value < 0.05	13	0.146	7,579	7,674	< 0.0001	0.305	0.744
Min-AIC	16	0.147	7,578	7,693	< 0.0001	0.306	0.745

The ROC curve for the Min-BIC model illustrates the sensitivity and specificity of the model and reflects the goodness of fit. The Min-BIC model has an AUC of 0.740, with the ROC curve shown in Figure 10.

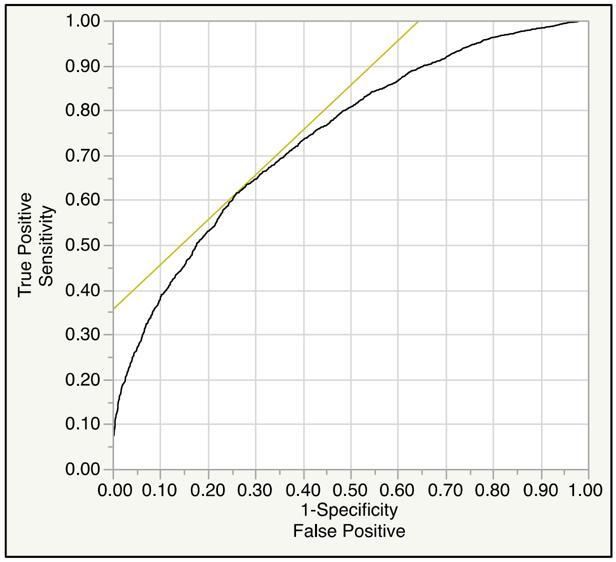


Figure 10. *ROC Curve for Min-BIC Model*. Using 2P as the response of interest results in an AUC of 0.740.

1. Regression Results

Equation (3) shows the resulting model from the min-BIC stepwise logistic regression. Variables x_{PFT}, x_{CORec}, x_{MCMAP}, and x_{AFQT} are treated as continuous variables, while $x_{AdverseInGrade}$, $x_{Race(Black)}$, x_{Taped}, and $x_{AdversePrior}$ are dichotomous variables. Dichotomous variables evaluate to [1] if the condition is true and [0] otherwise.

$$\begin{aligned}\text{logit}\left(\pi(\mathbf{x})\right) = 3.3 - 0.017x_{PFT} + 12.1\left(\frac{1}{x_{CORec}}\right) + 1.22x_{AdverseInGrade} - 0.64\log(x_{MCMAP}) \\ + \ 0.20x_{Race(Black)} - 0.009x_{AFQT} + 0.18x_{Taped} + 0.12x_{AdversePrior}\end{aligned} \quad (3)$$

Each of the variables in the final model is significant at the 0.05 level. Positive coefficients reflect a higher 2P likelihood when the value of the variable increases or is true, specifically $x_{AdverseInGrade}$, $x_{Race(Black)}$, x_{Taped}, and $x_{AdversePrior}$. Negative coefficients mean 2P likelihood decreases as the value of the variable increases or is true, such as x_{PFT}, x_{MCMAP}, and x_{AFQT}. The reciprocal transformation of x_{CORec} results in a large positive coefficient of 12.1 and requires a special interpretation. The reciprocal of x_{CORec} is always within the range of (0,1], so the impact of this term, and the 2P likelihood, is reduced as x_{CORec} increases. Additional details for each regressor are provided in Table 5.

Table 5. *Model Term Coefficient Estimates, Standard Error, Statistical Significance, Odds-Ratios, and Variable Importance*[4]. Each coefficient is rounded according to the corresponding standard error. Odds-ratios for continuous and ordinal terms are a comparison between the maximum and minimum values for that term, $e^{\beta_m(Max-Min)}$.

Term	**Estimate**	**Standard Error**	**Chi-Square**	**p-value**	**Odds-Ratio**	**Variable Importance**
Intercept	3.3	0.4	75	< 0.0001	-	-
x_{PFT}	– 0.017	0.001	346	< 0.0001	0.037	0.37
$1/x_{CORec}$	12.1	0.9	170	< 0.0001	8,730	0.23
$x_{AdverseInGrade}$	1.22	0.09	172	< 0.0001	11.4	0.22
$\log(x_{MCMAP})$	– 0.64	0.07	77	< 0.0001	0.32	0.07
$x_{Race(Black)}$	0.20	0.03	34	< 0.0001	1.5	0.03
x_{AFQT}	– 0.009	0.002	30	< 0.0001	0.5	0.03
x_{Taped}	0.18	0.04	25	< 0.0001	1.4	0.02
$x_{AdversePrior}$	0.12	0.04	10	0.0012	1.3	0.01

2. Regression Variables

Variables x_{PFT}, x_{MCMAP}, and x_{AFQT} are all objective indicators of a Marine's performance at the time of reenlistment; as the value of these variable increases, 2P likelihood decreases. PFT score, x_{PFT}, is the most important variable in determining response variability with a variable importance of 0.37, which is the approximate

[4] Variable importance is determined via JMP using independent resampled inputs of each term. JMP uses Monte Carlo runs to simulate the variability in predicted response based on variations of each factor, with higher variability in the response signifying greater importance of that factor (SAS Institute Inc).

proportion of variance explained. PFT inclusion makes sense as a 2P predictor due to the Marine Corps focus on physical fitness. MCMAP belt attainment, x_{MCMAP}, is significant, particularly if a Marine is unqualified or has a lower belt level at the time of reenlistment. Because MCMAP is largely a voluntary advancement program, this may be representative of a Marine's intangible characteristics, such as motivation or drive. Even after 10 or more years in service, AFQT score, x_{AFQT}, is still a significant predictor of success at this rank, where a higher score reflects a lower 2P likelihood. In addition to these objective indicators, Commander's Recommendation is a strong 2P indicator.

Commander's Recommendation, x_{CORec}, is the only subjective measure of performance included and is also positively correlated to promotion potential. Inclusion of subjective measures is important as a means of capturing the intangible qualities of an individual. Without available fitness report data, the Commander's Recommendation is the only subjective measure available. The reciprocal of x_{CORec} is used in the model due to the stronger impact of negative recommendations, resulting in the largest odds-ratio of the selected variables. A negative recommendation from a Staff Sergeant's Commanding Officer, "Not Recommended" or "Recommended with Reservation," is a strong 2P predictor. A Staff Sergeant "Not Recommended" for reenlistment has 8,730 times higher odds of being 2P than one "Recommended with Enthusiasm." The other impact of the reciprocal transformation is that the influence of the reciprocal term decreases as x_{CORec} increases. This matches the results of the univariate analysis and reflects the emphasis that should be placed on a negative Commander's Recommendation during reenlistment decisions.

Variables $x_{AdverseInGrade}$, x_{Taped}, and $x_{AdversePrior}$ are each unfavorable indicators of a Marine's performance at the time of reenlistment and increase 2P likelihood when true. All adverse material is significant; however, adverse material in grade, $x_{AdverseInGrade}$, has a much stronger relationship to being 2P with an odds-ratio of 11.4 compared to 1.3 for adverse material prior to the rank of Staff Sergeant, $x_{AdversePrior}$. Marines above the maximum weight for their corresponding height, x_{Taped}, also have a higher likelihood of being 2P. Although this does not necessarily mean they are out of standards, it reflects the Marine Corps view on the importance of body composition. These variables are negatively correlated to a Marine's future promotion potential.

The inclusion of racial identifiers, specifically $x_{Race(Black)}$, as a significant predictor of 2P Staff Sergeants should give pause, as it is the only variable which is not related to individual performance. After controlling for the other terms in the model, the odds of a black Marine being 2P are 1.5 times greater than the odds of being 2P if the Marine is not black. It is likely that there are externalities not accounted for in this model; however, it is unclear that another variable would explain this apparent bias. Further, it is not possible to discern from the current data whether this bias derives from the retention, evaluation, or promotion processes.

B. MODEL VALIDATION

The selected model is validated using a test set, 20 percent of the original sample excluded at random during model development and selection. Using the established test set, the misclassification rate is evaluated and compared to that of the training set for each of the three developed models. In each of the models, there is an increase in misclassification of the test set of around 2.5 percentage points, as shown in Table 6. A modest increase in the misclassification rate is expected, and this result confirms the similar performance of the three models. This helps to validate the selection of the Min-BIC model for its simplicity and similar performance relative to the other tested models.

Table 6. *Misclassification Rate Comparison Between Training and Test Sets.* The misclassification rate for the test set increases by approximately 2.5 percent for each of the models.

Model	**Training Set (n = 6,557)**	**Test Set (n = 1,594)**	**Change in Misclass Rate**
Min-BIC (Selected)	0.310	0.334	0.024
P-Value < 0.05	0.305	0.332	0.027
Min-AIC	0.306	0.330	0.024

In addition to evaluating overall misclassification rates, the models are tested for their ability to identify those Marines most likely to be 2P. Those Marines with the highest 2P likelihood are those who would be denied reenlistment if this model were used as a quality screen. The percentage of Type I errors, or false positives, is a stronger measure of effectiveness for a model where it is more important to identify the lowest quality Marines. Type I error rates indicate the proportion of Marines erroneously identified as 2P at various quality screen levels, as shown in Figure 11. Type I error rates on the test set are lower than the overall misclassification rates. Although the Min-BIC misclassification rate is 0.334, the Type I error for a 20-percent quality screen is only 0.269. Again, it is shown that the min-BIC model has similar performance to the more complex models created using min-AIC and p-value < 0.05 stepwise criteria.

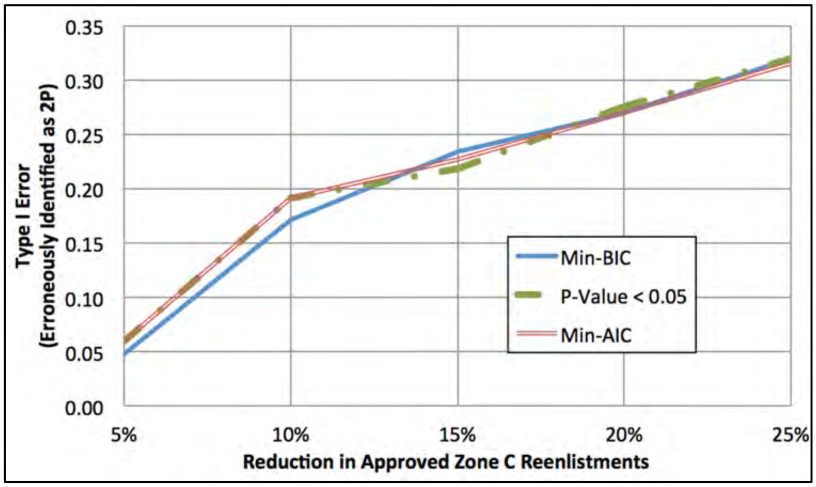


Figure 11. *Type I Error Identifying 2P Staff Sergeants in the Test Set*. Three models are evaluated for their ability to predict 2P Staff Sergeants as a quality screen during Zone C reenlistments. Type I Error increases as the percent reduction in approved reenlistments is increased. A 20-percent quality screen results in a Type I error rate of 0.269 for the Min-BIC model.

C. SUMMARY

This analysis identifies predictors of performance as they relate to 2P likelihood. The logistic regression results suggest that low PFT scores, negative commander's recommendations, and adverse material in grade should be strongly considered when making retention decisions, but the results also show some of the difficulties of projecting 2P Staff Sergeants at the time of reenlistment. Even for a quality screen that is attempting to identify only the bottom 20 percent of performers, 26.9 percent of those identified would incorrectly predicted as 2P. This does not mean a Zone C quality screen cannot provide value, but that a quality screen will not result in a one-to-one reduction in 2P Staff Sergeants for each Marine separated. Although there is potential to improve this model with the future inclusion of fitness report data, there would still be a non-zero misclassification rate. For the purpose of policy comparison, the Type I error rates associated with the Min-BIC model are used in the following chapters as a reasonable approximation of error rates for a Zone C quality screen.

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V. MARKOV MODELS: ENLISTED PROMOTIONS

This analysis uses a Markov model to determine the impact of 2P Staff Sergeant policy alternatives on the enlisted promotion system. Markov models must meet three primary assumptions: the system consists of finite states, the probability of transition to the next state depends only on the current state (the Markov property), and the system has stationary transition probabilities (Bartholomew, Forbes, & McClean, 1991). In the military, it is rare that transition rates in the promotion system are stationary due to the fluid nature of personnel policy and inventory targets. With a target end strength of 182,000 Marines, FY17 will be the first year since FY06 without a target increase or decrease in end strength (A.C. Fitzgerald, MPP-20, personal communication, 4 April 2015). DMDC and MPP-20 are the sources of data used for this analysis. The objective is to evaluate the efficacy of retention policy alternatives and their impact on the promotion system.[5]

The use of historical wastage rates and future inventory targets is a common requirement in manpower policy. This study uses optimization to determine the necessary steady-state recruitment and promotion rates, minimizing the sum of squared error between the target inventory and the calculated steady-state inventory. The use of recruitment and promotion rates as the decision variables simulates the military's promote-to-vacancy system. This method of analysis, using Markov models and optimization, addresses the issue of pairing historical rates and future inventories.

A. MARKOV MODEL

The transition matrix, **P**, for the Markov model establishes annual transition, or promotion, probabilities from grade *i* to grade *j*, as shown in Equation (4), where X_t represents the state of the system at time t. The wastage matrix, **W**, establishes annual transition probabilities from grade *i* to absorption state *k*, attrition or retirement, as shown

[5] Chapters V and VI are a continuation of work done in collaboration with Abbie J. Merkl in support of requirements for OS4701 – Manpower and Personnel Models, Naval Postgraduate School. Merkl contributed to variable definition, establishing historic transition rates, model validation, and optimization formulation.

in Equation (5). The model is structured such that each individual remains in the same grade, promotes, or leaves the system, resulting in Equation (6) (Bartholomew, Forbes, & McClean, 1991). These equations serve as the basis for the model development.

$$\mathbf{P} = \left\{ p_{i,j} \right\} = \left\{ P\left(X_{t+1} = j \mid X_t = i \right) \right\} \tag{4}$$

$$\mathbf{W} = \left\{ w_{i,k} \right\} = \left\{ P\left(X_{t+1} = k \mid X_t = i \right) \right\} \tag{5}$$

$$\sum_j p_{i,j} + \sum_k w_{i,k} = 1 \text{ , } \forall i \tag{6}$$

In this analysis, the primary modification from a traditional promotion model is that the rank of Staff Sergeant is split into two states, E6 and 2P E6, where the E6 state does not include any 2P Staff Sergeants. The analysis and policy implementation will focus on these two states. A number of additional simplifications are made for ease of understanding the model as depicted in Figure 12 and Table 7. Demotions are not considered at any grade. The Marine Corps does not distinguish between grades E1, E2, and E3 for inventory targets, so these grades are combined into one state, E1-E3, and all recruitment flows into this state. Although grades E1 to E5 have a small number of retirements and grade E7 to E9 have some level of attrition, a distinction for the type of wastage is unnecessary outside of the E6 and 2P E6 states, which is the focus of analysis. All Staff Sergeant retirements are assumed to be from the 2P E6 state, since it is unlikely for a Staff Sergeant to reach retirement eligibility without two promotion opportunities.

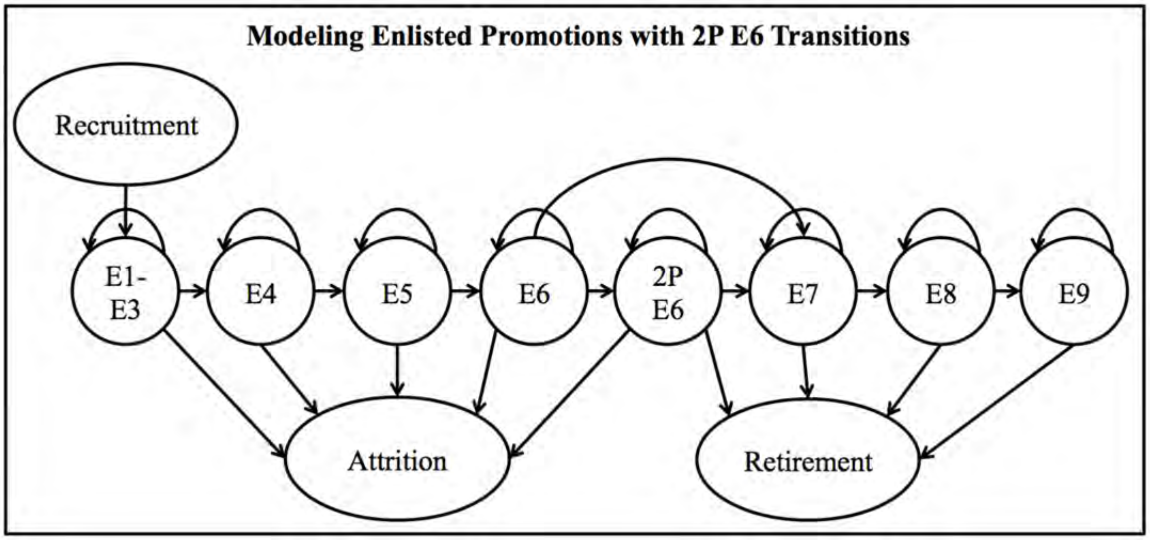


Figure 12. *Markov Model for Marine Corps Enlisted Promotions with 2P E6 Transitions*. The primary modification from a traditional promotion process is the addition of a 2P E6 state.

Table 7. *Markov Transition Matrix for Marine Corps Enlisted Promotions with 2P E6 Transitions*. The primary modification from a traditional promotion process is the addition of a 2P E6 state.

	E1-E3	E4	E5	E6 (Non-2P)	2P E6	E7	E8	E9	ATTRITE	RETIRE
E1-E3	p(E3,E3)	p(E3,E4)	-	-	-	-	-	-	w(E3,ATT)	-
E4	-	p(E4,E4)	p(E4,E5)	-	-	-	-	-	w(E4,ATT)	-
E5	-	-	p(E5,E5)	p(E5,E6)	-	-	-	-	w(E5,ATT)	-
E6 (Non-2P)	-	-	-	p(E6,E6)	p(E6,2P)	p(E6,E7)	-	-	w(E6,ATT)	-
2P E6	-	-	-	-	p(2P,2P)	p(2P,E7)	-	-	w(2P,ATT)	w(2P,RET)
E7	-	-	-	-	-	p(E7,E7)	p(E7,E8)	-	-	w(E7,RET)
E8	-	-	-	-	-	-	p(E8,E8)	p(E8,E9)	-	w(E8,RET)
E9	-	-	-	-	-	-	-	p(E9,E9)	-	w(E9,RET)
ATTRITE	-	-	-	-	-	-	-	-	1	-
RETIRE	-	-	-	-	-	-	-	-	-	1

B. DATASETS

Data used for the Markov model is derived from three sources: DMDC, MPP-20, and the Marine Corps Grade Adjusted Recapitulation (GAR). DMDC provides details on annual transitions by grade, which is used to establish historical wastage rates. MPP-20 provides data on Gunnery Sergeant promotion boards and the inventory of 2P Staff Sergeants, which establishes a basis for 2P E6 state transitions and inventory. The GAR publishes the annual Marine Corps inventory targets by grade and MOS. The data available is sufficient to create a steady-state model via optimization.

1. Defense Manpower Data Center

Manpower policies are rarely, if ever, given time to reach a steady state; any time target end strength changes, it impacts transition and wastage rates from all grades. The DMDC data, reference DRS86912, includes historical personnel flows for recruitment, promotion, demotion, attrition, and retirement. Although transition data is available through FY14, the objective is to compare policy alternatives in a steady-state environment. For this reason, wastage rates are estimated using only data from FY04 through FY06, which is prior to the FY07 increase in target end strength and subsequent drawdown. This provides an approximation for wastage rates in a steady-state environment. The DMDC data does not include information on the 2P E6 state or inventory targets, and it must be supplemented by additional sources.

2. MPP-20

MPP-20 provides historical data for Gunnery Sergeant promotion boards and 2P Staff Sergeant inventories. The analysis of previous Gunnery Sergeant promotion boards includes the size and composition of the eligible Staff Sergeant population and those selected for promotion. This is used to derive the annual flow from E6 to 2P E6 and from 2P E6 to E7. Similar to the use of FY04 to FY06 historical wastage rates, it is assumed that the 2P E6 state transitions from this period are a good approximation for future steady-state 2P E6 transition rates. The inventory of 2P Staff Sergeants, also provided by MPP-20, establishes a basis for estimating the proportion of 2P E6 in the total Staff Sergeant inventory. From FY03 through FY14, 2P Staff Sergeants represent 15.7 percent of the total Staff Sergeant inventory, with a 1.6 percent standard deviation, as shown in Figure 13.

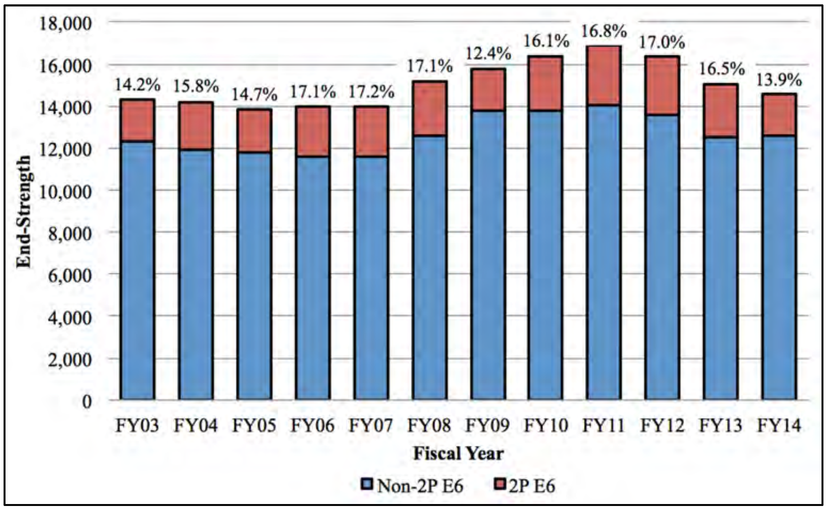


Figure 13. *Proportion of 2P and Non-2P Staff Sergeants by Fiscal Year.* The historical proportion of 2P Staff Sergeants is 15.7±1.6 percent from FY03-FY14 Staff Sergeant end strength.

3. Grade Adjusted Recapitulation

The Marine Corps publishes inventory targets by grade and MOS twice per year through the GAR. GAR inventory targets are referenced by target year and a letter designation representing the date published; for example, the 2017PP GAR indicates the FY17 inventory targets published in Spring 2015, designated by the code PP. For this analysis, the 2017PP GAR targets are selected as the initial inventory and target steady-state conditions for the base-case model, as FY17 end-strength targets will remain stationary for the foreseeable future.

C. VARIABLES

To adequately compare retention policy alternatives, this analysis evaluates the impact of these policies under steady-state inventory conditions. Steady-state inventory, in this sense, is not limited to just total end strength, but also end strength by grade. As a basis for comparison, a base-case Markov model uses historical wastage rates during a period inventory when inventory was relatively constant. This assumes retention policies during the last stable inventory period would result in wastage rates similar to those of future stable inventory periods. The last period when Marine Corps inventories were stable, from which to derive wastage rates, was from FY04 to FY06. Target inventories have been in a state of fluctuation since FY06, and the next period of stable inventory targets is expected to begin in FY17. The base-case model pairs FY17 inventory targets with historical wastage rates. The variables of interest for the base-case model optimization include inventory, recruitment, transition, and wastage data, as defined in Table 8. The optimization of decision variables establishes the base-case enlisted promotion model and provides a basis for evaluating policy alternatives.

Table 8. *Indices, Sets, Data, and Decision Variables for the Base-Case Optimization*. The indices refer to the transition and wastage matrices from Table 7.

	Notation	Description
Index and Set Use	i	Grade at time t
	j	Grade or state at time $t + 1$
	k	Wastage at time $t + 1$
	$\mathbf{P} = \{p_{i,j}\}$	Transition matrix
	$\mathbf{I}$	Identity matrix
Derived Data	$\mathbf{n_0}$	Initial inventory
	$\mathbf{r}$	Recruitment vector
	$p_{E6,2P}$	Transition probability from E6 to 2P E6
	$p_{2P,E7}$	Transition probability from 2P E6 to E7
	$w_{E3,ATT}$	Wastage probability from E1-E3 to Attrition
	$w_{E4,ATT}$	Wastage probability from E4 to Attrition
	$w_{E5,ATT}$	Wastage probability from E5 to Attrition
	$w_{2P,RET}$	Wastage probability from 2P E6 to Retirement
	$w_{E7,RET}$	Wastage probability from E7 to Retirement
	$w_{E8,RET}$	Wastage probability from E8 to Retirement
	$w_{E9,RET}$	Wastage probability from E9 to Retirement
	ssgt_attrition	Total Staff Sergeant wastage probability from E6 and 2P E6 to Attrition
Decision Variables	R	Total recruitment
	$p_{i,i}$	Same state transition probabilities
	$p_{E3,E4}$	Transition probability from E1-E3 to E4
	$p_{E4,E5}$	Transition probability from E4 to E5
	$p_{E5,E6}$	Transition probability from E5 to E6
	$p_{E6,E7}$	Transition probability from E6 to E7
	$p_{E7,E8}$	Transition probability from E7 to E8
	$p_{E8,E9}$	Transition probability from E8 to E9
	$w_{E6,ATT}$	Wastage probability from E6 to Attrition
	$w_{2P,ATT}$	Wastage probability from 2P E6 to Attrition

1. Inventory and Recruitment Vectors

The recruitment vector, **r**, establishes the proportion of recruits entering each grade, or state. For this model, recruits enter only the E1-E3 state. The number of recruits, *R*, is constant year over year and determined using optimization. The initial inventory vector, $\mathbf{n_0}$, is derived using the 2017PP GAR targets and the mean historical proportion of 2P Staff Sergeants from FY03-FY14. The 2017PP GAR also establishes the target inventory for the system to reach at steady state, where the E6 and 2P E6 states combine for the total Staff Sergeant target. The recruitment, initial inventory, and target inventory vectors are shown in Table 9.

Table 9. *Inventory and Recruitment Vectors.* The recruitment vector designates that all recruits, R, enter the E1-E3 state. The initial inventory is derived from the 2017PP GAR and historical 2P proportions. The 2017PP GAR establishes the target inventory.

	E1-E3	E4	E5	E6	2P E6	E7	E8	E9
Recruitment Vector (r)	1	0	0	0	0	0	0	0
Initial Inventory ($\mathbf{n_0}$)	68,652	37,308	26,185	12,802	2,384	8,338	3,837	1,582
2017PP GAR Target Inventory	68,652	37,308	26,185	15,186		8,338	3,837	1,582

2. Transition Matrix

The transition matrix, **P**, consists of annual transition probabilities, $p_{i,j}$., between grades. The probability of demotion from any grade is set to zero, and promotions only occur one grade at a time. This analysis uses optimization to determine the promotion rates required to maintain the steady-state inventory; however, the transitions from E6 to 2P E6 ($p_{E6,2P}$) and from 2P E6 to E7 ($p_{2P,E7}$) must be estimated using historical data. These probabilities are approximated using Equation (7), where $n_{t_{i,j}}$ is the annual personnel flow from state *i* to state *j* in fiscal year *t*, and n_{t_i} is the end strength of state *i* in fiscal year *t* (Bartholomew, Forbes, & McClean, 1991).

$$\hat{p}_{i,j} = \frac{\sum_t n_{t_{i,j}}}{\sum_t n_{(t-1)_i}},\ t \in (FY04, FY05, FY06) \tag{7}$$

An analysis of FY04 through FY06 Gunnery Sergeant Promotion Board results and DMDC data establish the personnel flows required. This period is used because it is the last time period without a targeted increase or decrease in overall end strength, which would impact transition and wastage rates. The resulting transition rates and standard deviations are $p_{E6,2P} = 0.07 \pm 0.02$ and $p_{2P,E7} = 0.13 \pm 0.01$. Although standard deviations are provided for historical transition rates, the analysis uses only the mean rate.

3. Wastage Matrix

The wastage matrix, **W**, is comprised of attrition and retirement probabilities for each grade and is derived from the DMDC data. For simplification, all wastage for grades E1 through E5 is included in the attrition flows, and all wastage for grades E7 through E9 is included in the retirement flows. For the E6 and 2P E6 wastage rates, all Staff Sergeant retirements are assumed to be from the 2P E6 state. These simplifications do not impact the desired measures of effectiveness surrounding the E6 and 2P E6 states. The wastage probabilities are estimated using Equation (8), with a similar definition similar to that of Equation (7).

$$\hat{w}_{i,k} = \frac{\sum_t n_{t_{i,k}}}{\sum_t n_{(t-1)_i}},\ t \in (FY04, FY05, FY06) \tag{8}$$

The total attrition rate for Staff Sergeants, *ssgt_attrition*, is determined using Equation (8), where $k=ATT$ and the flows available from DMDC, $n_{i,k}$, are for the total Staff Sergeant population. Variables $w_{E6,ATT}$ and $w_{2P,ATT}$ are evaluated during optimization using Equation (9) as a constraint, where *ssgt_attrition* = 0.071 ± 0.003.

$$n_{0_{E6}} w_{E6,ATT} + n_{0_{2P}} w_{2P,ATT} = \left(n_{0_{E6}} + n_{0_{2P}}\right) * ssgt\_attrition \tag{9}$$

The resulting wastage rates are shown in Table 10.

Table 10. *Historical Wastage Probabilities And Standard Deviations By Grade*. DMDC data is used to estimate the probability of attrition and retirement from each state. E6 and 2P E6 attrition are determined through optimization.

<table>
<tr><th></th><th>E1-E3</th><th>E4</th><th>E5</th><th>E6</th><th>2P E6</th><th>E7</th><th>E8</th><th>E9</th></tr>
<tr><td>Attrition ($w_{i,ATT}$)</td><td>0.129 $\pm$ 0.004</td><td>0.36 $\pm$ 0.01</td><td>0.179 $\pm$ 0.007</td><td colspan="2">ssgt_attrition</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Retirement ($w_{i,RET}$)</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.15 $\pm$ 0.01</td><td>0.12 $\pm$ 0.01</td><td>0.18 $\pm$ 0.02</td><td>0.20 $\pm$ 0.01</td></tr>
</table>

D. ENLISTED PROMOTION MODEL BASE CASE

The base-case model of the enlisted promotion process uses optimization to determine the recruitment and promotion rates required to achieve the targeted 2017PP GAR inventory, as shown in Figure 14 and Table 11. The results of the base case are the foundation by which to model potential policy changes. Changes in personnel policy can be modeled by determining specific wastage or transition rates being targeted by the policy. Targeted changes to these rates are used to evaluate the impact of policy implementation.

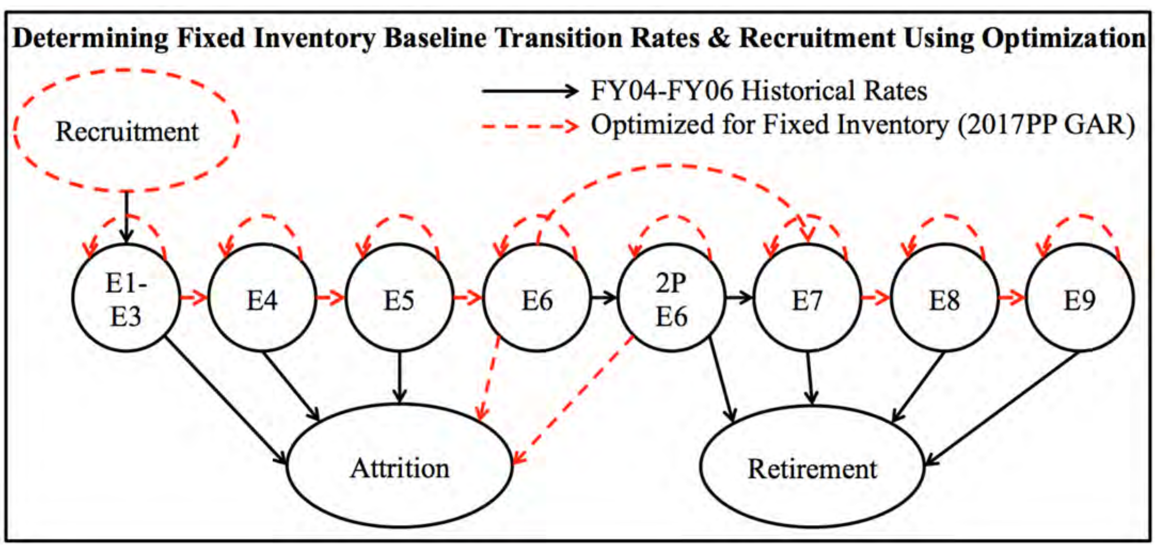


Figure 14. *Markov Model for Base-Case Optimization with Fixed Inventory*. The red dashed lines represent decision variables, which are determined through optimization. The black solid lines are derived data from FY04 through FY06.

Table 11. *Markov Transition Matrix for Base-Case Optimization with Fixed Inventory*. The red dashed lines represent decision variables, which are determined through optimization. The black solid lines are derived data from FY04 through FY06, showing calculated rates and standard deviations for historical rates.

	E1-E3	E4	E5	E6 (Non-2P)	2P E6	E7	E8	E9	ATTRITE	RETIRE
E1-E3	p(E3,E3)	p(E3,E4)	-	-	-	-	-	-	0.13 ± 0.00	-
E4	-	p(E4,E4)	p(E4,E5)	-	-	-	-	-	0.36 ± 0.01	-
E5	-	-	p(E5,E5)	p(E5,E6)	-	-	-	-	0.18 ± 0.01	-
E6 (Non-2P)	-	-	-	p(E6,E6)	0.07 ± 0.02	p(E6,E7)	-	-	w(E6,ATT)	-
2P E6	-	-	-	-	p(2P,2P)	0.13 ± 0.01	-	-	w(2P,ATT)	0.15 ± 0.01
E7	-	-	-	-	-	p(E7,E7)	p(E7,E8)	-	-	0.12 ± 0.01
E8	-	-	-	-	-	-	p(E8,E8)	p(E8,E9)	-	0.18 ± 0.02
E9	-	-	-	-	-	-	-	p(E9,E9)	-	0.20 ± 0.01
ATTRITE	-	-	-	-	-	-	-	-	1	-
RETIRE	-	-	-	-	-	-	-	-	-	1

HISTORICAL TRANSITION RATE

OPTIMIZED TRANSITION RATE

1. Base-Case Optimization Formulation

The base-case optimization formulation uses the notation, indices, sets, derived data, and decision variables established in Table 8. The objective for the base-case optimization, Equation (10), is to minimize the sum of squared differences between the steady-state inventory and the inventory targets by grade. The target inventory is the same as the initial inventory, but the E6 and 2P E6 states are combined to minimize the squared difference for the total number of Staff Sergeants. The full formulation includes Equations (10) through (13).

$$\min \sum_j \left[\left(R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \right)_j - n_{0_j} \right]^2 + \left[\left(R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \right)_{E6} + \left(R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \right)_{2P} - \left(n_{0_{E6}} + n_{0_{2P}} \right) \right]^2, j \neq E6, 2P \quad (10)$$

$$\text{s.t.} \quad \sum_j p_{i,j} + \sum_k w_{i,k} = 1, \ \forall i \quad (11)$$

$$n_{0_{E6}} w_{E6,ATT} + n_{0_{2P}} w_{2P,ATT} = \left(n_{0_{E6}} + n_{0_{2P}} \right) * ssgt\_attrition \quad (12)$$

$$p_{i,j} \geq 0; \ w_{i,k} \geq 0; \ R \geq 0 \quad (13)$$

The first constraint, Equation (11), ensures that the probabilities of transition or wastage from each state sum to one. The second constraint, Equation (12), forces the attrition from the E6 and 2P E6 states to total Staff Sergeant attrition. The third constraint, Equation (13), establishes that transition rates, wastage rates, and recruitment are positive.

2. Base Case Results

The optimal value of the base-case optimization is zero, meaning there is no difference between the steady-state inventory and the initial inventory; a stable promotion system is achieved. Equation (14) shows the calculation for the steady-state inventory of the system, **n*** (Bartholomew, Forbes, & McClean, 1991).

$$\mathbf{n}^* = R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \tag{14}$$

In addition to achieving the target inventory, the steady-state inventory for the base-case model achieves the appropriate historical proportion of 2P Staff Sergeants, 15.7 percent of the total Staff Sergeant inventory, as shown in Table 12.

Table 12. *Base-Case Optimization for Steady-State Inventory*. The result of the optimization is a stable promotion system with no change from initial to steady-state inventory. 2P E6 is 15.7 percent of the total inventory of Staff Sergeants.

	E1-E3	**E4**	**E5**	**E6**	**2P E6**	**E7**	**E8**	**E9**
Steady-State Inventory (n*)	68,652	37,308	26,185	12,802	2,384	8,338	3,837	1,582

The optimal solution for the model provides the promotion rates for each state that are required to maintain the steady-state inventory, as shown in Table 13. Wastage rates for the base case from E6 and 2P E6 to Attrition are established as $w_{E6,ATT} = 0.07$ and $w_{2P,ATT} = 0.09$. The number of recruits, R, required to enter the system each year is 30,320.

Table 13. *Markov Transition Matrix Resulting from Base-Case Optimization*. The results show transition rates required to maintain steady-state inventory for the base-case scenario. Due to rounding, rows may not sum to one.

	E1-E3	E4	E5	E6 (Non-2P)	2P E6	E7	E8	E9	ATTRITE	RETIRE
E1-E3	0.56	0.31	-	-	-	-	-	-	0.13 ± 0.00	-
E4	-	0.42	0.22	-	-	-	-	-	0.36 ± 0.01	-
E5	-	-	0.69	0.13	-	-	-	-	0.18 ± 0.01	-
E6 (Non-2P)	-	-	-	0.73	0.07 ± 0.02	0.14	-	-	0.07	-
2P E6	-	-	-	-	0.64	0.13 ± 0.01	-	-	0.09	0.15 ± 0.01
E7	-	-	-	-	-	0.75	0.12	-	-	0.12 ± 0.01
E8	-	-	-	-	-	-	0.73	0.08	-	0.18 ± 0.02
E9	-	-	-	-	-	-	-	0.80	-	0.20 ± 0.01
ATTRITE	-	-	-	-	-	-	-	-	1.00	-
RETIRE	-	-	-	-	-	-	-	-	-	1.00

HISTORICAL TRANSITION RATE | OPTIMIZED TRANSITION RATE

E. SUMMARY

The results of the base-case model show a stable model that successfully reaches the target inventory, providing a foundation for policy analysis. This enables policy comparisons in terms of promotion rates, wastage rates, inventory impacts, and recruitment requirements. Specifically, these impacts are evaluated for a quality screen at reenlistment and a non-retention policy for 2P Staff Sergeants. The objective is to evaluate the efficacy of 2P retention policy alternatives and their impact on the promotion system. The evaluation of quality screen and non-retention policy models in Chapter VI reveals the impact of these policies under steady-state inventory conditions.

VI. MARKOV MODELS: POLICY ALTERNATIVES

This analysis uses the base-case enlisted promotions model to compare retention policy alternatives and determine their impact on the inventory and promotion system. This study considers two alternatives to the base case: a quality screen at the time of Zone C reenlistment and a policy of non-retention of 2P Staff Sergeants. These alternatives can be realized in the Markov model through the modification of targeted transition and wastage rates, establishing new recruitment and promotion rates through optimization. A quality screen is more effective than the non-retention policy at reducing the proportion of Staff Sergeants who transition to the 2P E6 state, however, the non-retention policy, is more effective at reducing the 2P Staff Sergeants in the steady-state inventory.

A. ZONE C QUALITY SCREEN

The first policy alternative considered is a quality screen at the time of Zone C reenlistment. A quality screen is a reduction in the number of approved reenlistments, applying screening criteria to reduce the number of likely 2P Staff Sergeants. An illustration of the quality screen Markov model is shown in Figure 15.

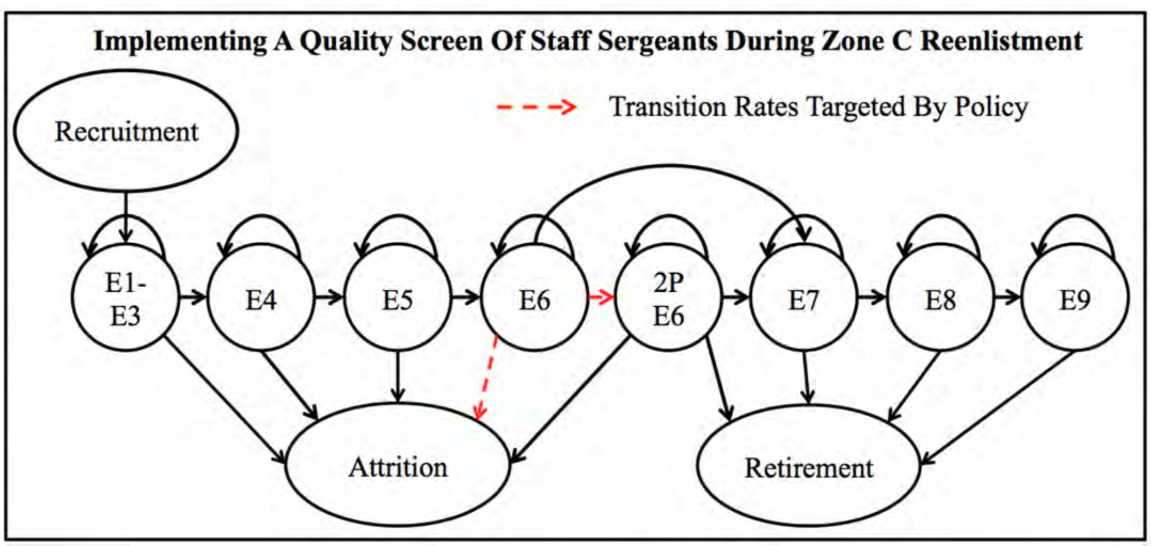


Figure 15. *Markov Model for Quality Screen at Reenlistment.* An increase in reenlistment selectivity is modeled as an increase in the E6 attrition rate and a decrease in the probability of transition from E6 to 2P E6.

The historical proportion of the total Staff Sergeant inventory that reenlists through an approved Zone C request is approximately 12 percent. A quality screen reduces this reenlistment rate, and optimization provides the required recruitment and promotion rates under this policy alternative. The optimization formulation is similar to that of the base case, with relevant variables defined in Table 14.

Table 14. *Indices, Sets, Data, and Decision Variables for Policy Alternative Optimizations*. For the policy alternatives, wastage rates are derived from the base-case results.

	Notation	Description
Index and Set Use	i	Grade at time t
	j	Grade or state at time $t + 1$
	k	Wastage at time $t + 1$
	$\mathbf{P} = \{p_{i,j}\}$	Transition matrix
	$\mathbf{I}$	Identity matrix
Derived Data	$\mathbf{W} = \{w_{i,k}\}$	Wastage matrix
	$\mathbf{n_0}$	Initial inventory
	$\mathbf{r}$	Recruitment vector
	$p_{E6,2P}$	Transition probability from E6 to 2P E6
	$p_{2P,E7}$	Transition probability from 2P E6 to E7
Decision Variables	R	Total recruitment
	$p_{i,i}$	Same state transition probabilities
	$p_{E3,E4}$	Transition probability from E1-E3 to E4
	$p_{E4,E5}$	Transition probability from E4 to E5
	$p_{E5,E6}$	Transition probability from E5 to E6
	$p_{E6,E7}$	Transition probability from E6 to E7
	$p_{E7,E8}$	Transition probability from E7 to E8
	$p_{E8,E9}$	Transition probability from E8 to E9

1. Variables

As discussed in Chapter IV, there is some Type I error rate associated with any screening criteria, $errorRate_{qScreen\%}$. The variable $qScreen\%$ is the percent reduction in approved reenlistments for a given quality screen level. For instance, a 20-percent quality screen has an $errorRate_{20\%}$ of 0.269. The quality screen uses an effective 2P reduction rate, $reductRate$, as defined by Equation (15). As the level of the quality screen increases, the Type I error rate for a quality screen increases, and $reductRate$ is reduced.

$$reductRate = qScreen\% * \left(1 - errorRate_{qScreen\%}\right) \qquad (15)$$

For the quality screen, inventory and recruitment vectors remain the same as the base case. There are two transition rates that are the primary emphasis of the policy, $p_{E6,2P_{qualityScreen}}$ and $w_{E6,ATT_{qualityScreen}}$. The implementation of a quality screen results in a reduction in the transition rate from E6 to 2P E6, $p_{E6,2P_{qualityScreen}}$. This rate is determined in a fashion similar to that of the base case. The flow from E6 to 2P E6 is reduced according to the effectiveness of the quality screen, as shown in Equation (16), where $n_{apprRELM}$ is the number of approved reenlistments from the base case and $n_{t_{i,j}}$ and n_{t_i} are as previously defined. For the steady-state inventory, a reenlistment rate of 12 percent results in a base-case $n_{apprRELM}$ of 1,825 Staff Sergeants.

$$p_{E6,2P_{qualityScreen}} = \frac{\sum_t n_{t_{E6,2P}} - n_{apprRELM} * reductRate_{qScreen\%}}{\sum_t n_{(t-1)_{E6}}},\ t \in (FY04, FY05, FY06) \qquad (16)$$

For a 20-percent quality screen, $p_{E6,2P_{qualityScreen}}$ = 0.06. The transition rate from 2P E6 to E7 is assumed to remain unchanged from the base case, $p_{2P,E7}$ = 0.13.

To achieve the reduction in the E6 to 2P E6 transition rate, a quality screen targets an increase in the wastage rate of E6 to Attrition from the base case. This wastage rate, $w_{E6,ATT_{qualityScreen}}$, is calculated using Equation (17), where $w_{E6,ATT_{baseCase}}$ is the optimal result for $w_{E6,ATT}$ from the base case, or 0.07, and *reenlRate* is the historical proportion of the total Staff Sergeant inventory that reenlists through an approved Zone C request, approximately 0.12.

$$w_{E6,ATT_{qualityScreen}} = w_{E6,ATT_{baseCase}} + qScreen\% * reenlRate \qquad (17)$$

For a 20-percent quality screen, this results in $w_{E6,ATT_{qualityScreen}}$ = 0.09. All other wastage rates are fixed to the results of the base-case model.

The implementation of a quality screen will result in a reduction of both 2P and non-2P Staff Sergeants. For instance, a 20-percent quality screen reduces approved Zone

C reenlistments by 365 annually compared to the base case and has an $errorRate_{20\%}$ of 0.269, indicating 98 Staff Sergeants are incorrectly identified as destined to become 2P. The efficiency of a quality screen continues to decrease until the number of non-2P Staff Sergeants separated exceeds the number of 2P Staff Sergeants separated. The quality screen model is evaluated for efficiency at levels from zero to 100 percent, with the results shown in Figure 16. For policy comparison purposes, the quality screen level is set to 20 percent.

Figure 16. *2P and Non-2P Staff Sergeants Denied Further Service Using Zone C Quality Screen.* A 20-percent reduction in approvals results in 267 correctly identified 2P Staff Sergeants and 98 Non-2P Staff Sergeants incorrectly identified.

2. Quality Screen Results

For the policy alternatives, the optimization objective, Equation (18), remains the same as the base case, minimizing the sum of squared differences between the target inventory and the steady-state inventory. Two of the three constraints, Equations (19) and (20), also remain as fundamental constraints of a Markov model. Wastage rates for E6 and 2P E6 attrition are not recalculated, as they are derived prior to the quality screen optimization. The full formulation for the policy alternatives optimization includes Equations (18) through (20).

$$\min \sum_j \left[\left(R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \right)_j - n_{0_j} \right]^2 + \left[\left(R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \right)_{E6} + \left(R\mathbf{r}(\mathbf{I}-\mathbf{P})^{-1} \right)_{2P} - \left(n_{0_{E6}} + n_{0_{2P}} \right) \right]^2, j \neq E6, 2P \quad (18)$$

$$\text{s.t.} \qquad \sum_j p_{i,j} + \sum_k w_{i,k} = 1, \ \forall i \quad (19)$$

$$p_{i,j} \geq 0; \ w_{i,k} \geq 0; \ R \geq 0 \quad (20)$$

The calculated wastage rates and E6 transition rates are paired with the 2017PP GAR initial inventory, $\mathbf{n_0}$, to determine the recruitment and promotion rates required to reach a steady-state system. The result of the optimization of Equations (18) through (20) is a stable system with zero difference between the steady-state and target inventories. The results of a 20-percent quality screen optimization are shown in Table 15.

Table 15. *Markov Transition Matrix for Twenty-Percent Quality Screen Model Results.* The red fills are the rates targeted by the policy. The red-dotted lines are optimization results.

	E1-E3	E4	E5	E6 (Non-2P)	2P E6	E7	E8	E9	ATTRITE	RETIRE
E1-E3	0.55	0.32	-	-	-	-	-	-	0.13 ± 0.00	-
E4	-	0.42	0.23	-	-	-	-	-	0.36 ± 0.01	-
E5	-	-	0.68	0.14	-	-	-	-	0.18 ± 0.01	-
E6 (Non-2P)	-	-	-	0.71	0.06	0.14	-	-	0.09	-
2P E6	-	-	-	-	0.64	0.13 ± 0.01	-	-	0.09	0.15 ± 0.01
E7	-	-	-	-	-	0.76	0.12	-	-	0.12 ± 0.01
E8	-	-	-	-	-	-	0.73	0.08	-	0.18 ± 0.02
E9	-	-	-	-	-	-	-	0.80	-	0.20 ± 0.01
ATTRITE	-	-	-	-	-	-	-	-	1.00	-
RETIRE	-	-	-	-	-	-	-	-	-	1.00

HISTORICAL TRANSITION RATE | TARGETED TRANSITION RATE | OPTIMIZED TRANSITION RATE

B. 2P NON-RETENTION POLICY

In addition to evaluating the impact of a quality screen on the promotion system, a policy of non-retention for 2P Staff Sergeants is evaluated. For the non-retention policy, all 2P Staff Sergeants are denied further service following their second pass for promotion, increasing the wastage rate from 2P E6 to Attrition, as shown in Figure 17.

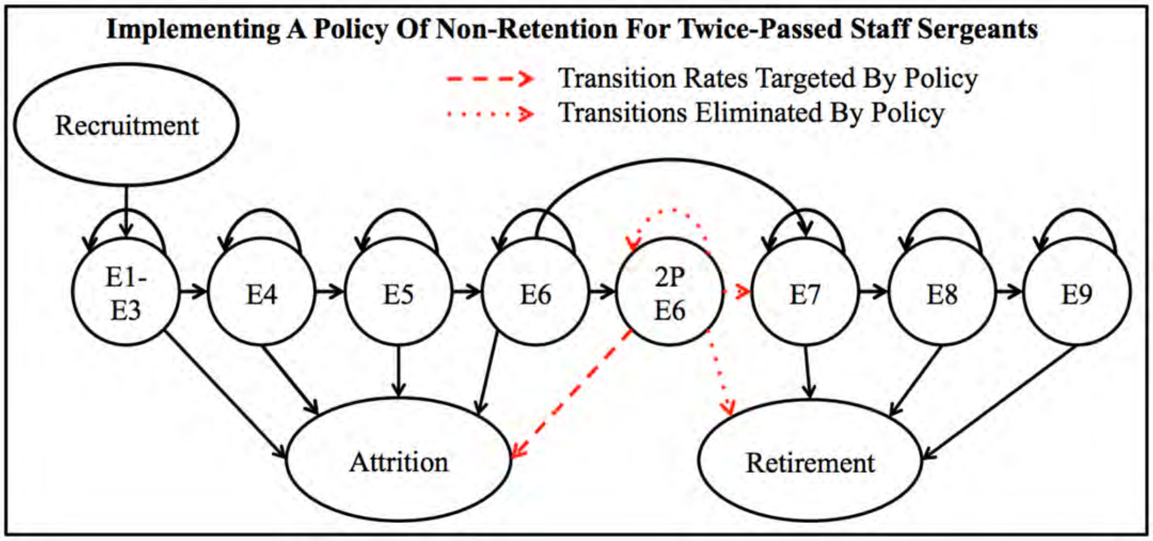


Figure 17. *Markov Model for Non-Retention Policy.* Separation of 2P Staff Sergeants is modeled as an increase in transition probability from 2P E6 to Attrite and elimination of the transition from 2P E6 to E7, Retirement, and back to 2P E6.

The mean TIS at the time of a 2P Staff Sergeant's second pass is 13.5 $\pm$ 1.7 years standard deviation for the FY07–FY11 Zone C reenlistment population, as shown in Figure 18. The average TIS for Zone C reenlistments is around 12 years, but only 17 percent of 2P Staff Sergeants have received their second pass at this point in their career. Sixty-three percent have been twice passed by 14 years, 93 percent by 16 years, and 99 percent by 18 years. Only 1 percent of 2P Staff Sergeants have reached retirement sanctuary prior to receiving their second pass.

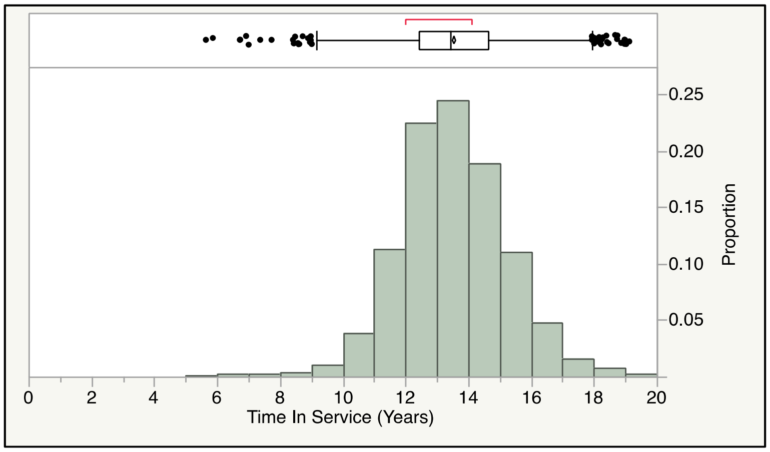


Figure 18. *Years Of Service At A Staff Sergeant's Second Pass For Promotion*. The mean time in service prior to becoming a 2P Staff Sergeant is 13.5 years with 1.7 years standard deviation. Data is derived from the FY07–FY11 Zone C reenlistment population.

1. Variables

In this analysis, there is no consideration for retirement sanctuary, and all 2P E6 are separated the year after reaching the 2P E6 state. The advantage of this type of policy is that it explicitly targets the 2P E6 state, so there is no error rate in identification. To model this policy, the optimization formulation is the same as the quality screen. The wastage rate from 2P E6 to Attrition, $w_{2P,ATT_{nonRetention}}$, is 100 percent. This reduces the wastage rate from 2P E6 to Retirement, $w_{2P,RET_{nonRetention}}$, to zero percent and forces the 2P E6 to E7 transition rate, $p_{2P,E7_{nonRetention}}$, to zero percent as well. All other wastage rates and the transition rate from E6 to 2P E6, $p_{E6,2P}$, are fixed to the result of the base-case model.

2. Non-Retention Results

The calculated wastage rates and 2P E6 transition rates are paired with the 2017PP GAR initial inventory, $\mathbf{n_0}$, to determine the recruitment and promotion rates required to reach a steady-state system. The result of the optimization from Equations (18) through (20) is a stable system with zero difference between the steady-state and target inventories. The results of the non-retention policy optimization are shown in Table 16.

Table 16. *Markov Transition Matrix for Non-Retention Policy Model*. The red fills are the rates targeted by the policy. The red-dotted lines are optimization results.

	E1-E3	E4	E5	E6 (Non-2P)	2P E6	E7	E8	E9	ATTRITE	RETIRE
E1-E3	0.55	0.32	-	-	-	-	-	-	0.13 ± 0.00	-
E4	-	0.41	0.23	-	-	-	-	-	0.36 ± 0.01	-
E5	-	-	0.67	0.15	-	-	-	-	0.18 ± 0.01	-
E6 (Non-2P)	-	-	-	0.72	0.07 ± 0.02	0.14	-	-	0.07	-
2P E6	-	-	-	-	-	-	-	-	1.00	-
E7	-	-	-	-	-	0.75	0.12	-	-	0.12 ± 0.01
E8	-	-	-	-	-	-	0.73	0.08	-	0.18 ± 0.02
E9	-	-	-	-	-	-	-	0.80	-	0.20 ± 0.01
ATTRITE	-	-	-	-	-	-	-	-	1.00	-
RETIRE	-	-	-	-	-	-	-	-	-	1.00

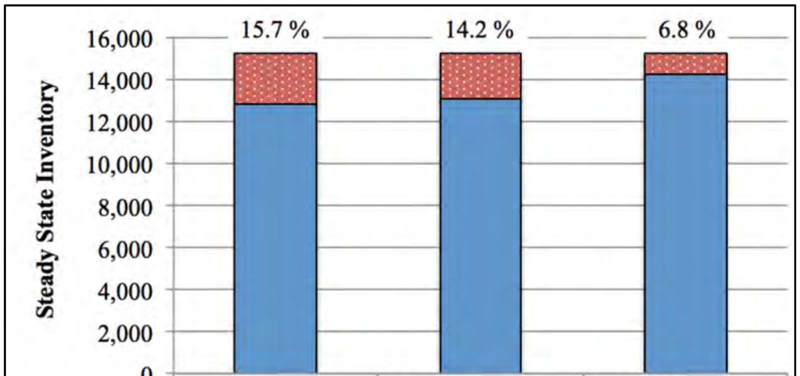
HISTORICAL TRANSITION RATE | TARGETED TRANSITION RATE | OPTIMIZED TRANSITION RATE

C. POLICY COMPARISONS

A review of the two alternative policies against the base case shows that a quality screen is more effective at reducing the percentage of Staff Sergeants that reach the 2P E6 state. Using a 20-percent quality screen, the percent of all Staff Sergeants who reach the 2P E6 state is reduced from 24.8 percent in the base case to 20.8 percent for the quality screen. This compares to 24.1 percent for non-retention policy. In addition to a decrease in the proportion of Staff Sergeants who become 2P, these policies impact the inventory of 2P Staff Sergeants, average TIG, promotion rates, and vary in implementation.

1. Inventory of Twice-Passed Staff Sergeants

The steady-state inventory of 2P E6 is most significantly impacted by the non-retention policy, with a 59.7 percent reduction from the base case compared to a 9.4 percent reduction for a quality screen. This reduction in 2P E6 inventory requires an additional 505 recruits annually for the non-retention policy and an additional 276 recruits annually for the quality screen. The total number of Staff Sergeants at steady state remains constant across all three policies; however, the non-retention policy reduces the percentage of 2P E6 to 6.8 percent of all Staff Sergeants, as shown in Figure 19.



	Base Case	Quality Screen	Non-Retention
2P E6	2,384	2,159	960
E6 (non-2P)	12,802	13,027	14,226

Figure 19. *Impact of Policy Changes on Steady-State E6 and 2P E6 Inventory*. A 20-percent quality screen results in a 9.4 percent reduction in 2P E6 from the base case. A policy of non-retention results in a 59.7 percent reduction in 2P E6.

2. Average Time In Grade

The average TIG for each rank is compared across the three policies. The only two grades that experience an appreciable change in average TIG are Sergeants and Staff Sergeants. The average TIG reduction for Sergeants is due to an increase in promotion rate, whereas, the reduction for Staff Sergeants is primarily due to fewer 2P E6, who tend to remain in that state for longer periods of time. These results derive from Equation (21), where **S** is the fundamental matrix and $s_{i,j}$ is the expected time spent in state j, given a starting point of state i (Bartholomew, Forbes, & McClean, 1991).

$$\mathbf{S} = \left(\mathbf{I} - \mathbf{P}\right)^{-1} \tag{21}$$

The average TIG for all Staff Sergeants is 4.4 years, 4.0 years, and 3.8 years for the base case, quality screen, and non-retention policies, respectively, as shown in Figure 20.

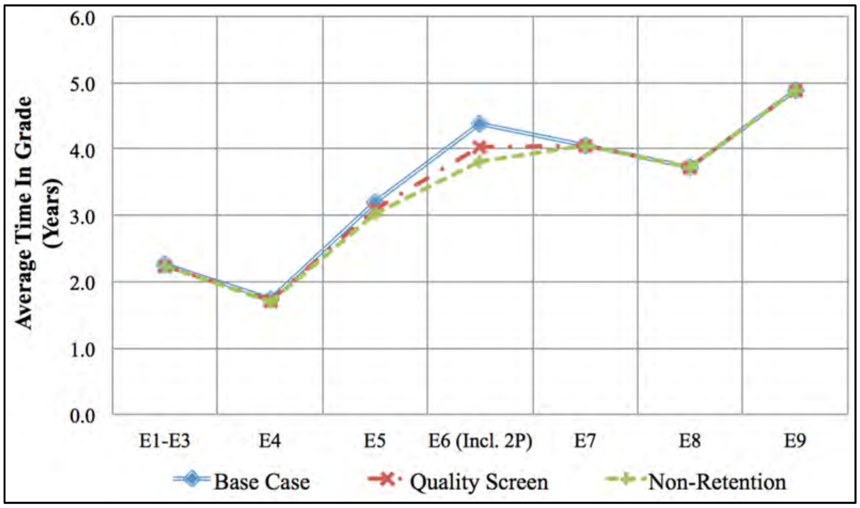


Figure 20. *Impact of Policy Changes on Average TIG.* For Staff Sergeants, average TIG is reduced from 4.4 years to 3.8 years with a 2P non-retention policy. Sergeants (E5) experience the only other significant reduction in average TIG, which goes from 3.2 years in the base case to 3.0 years for the non-retention policy.

3. Promotion Rates

The increased level of attrition from the Staff Sergeant rank, for both the quality screen and non-retention policies, has the effect of increasing the rate of promotion for the lower ranks. The largest increases in promotion rates for each grade are as a result of the non-retention policy. The grade of E5 has the largest change in annual promotion rate, which goes from 13.3 percent in the base case to 14.3 percent for the quality screen and 15.2 percent for the non-retention policy, as shown in Figure 21. Staff Sergeants and above do not experience an increase in promotion rate.

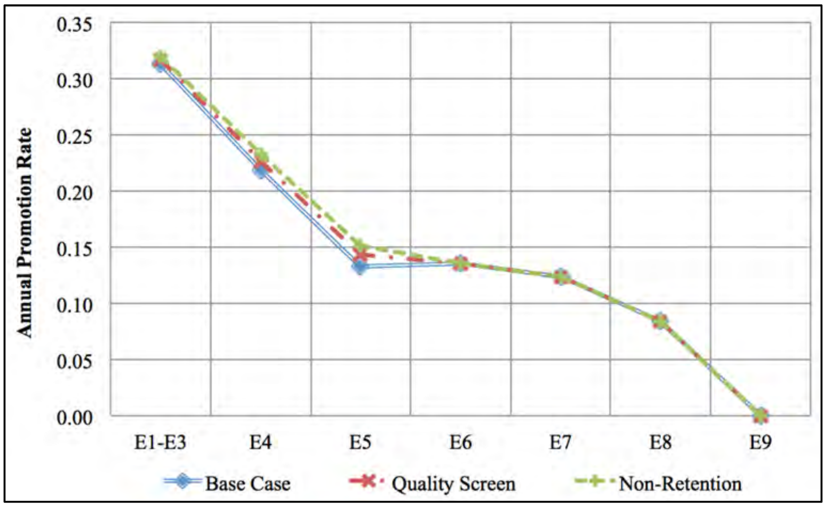


Figure 21. *Impact of Policy Changes on Annual Promotion Rates.* The first three states experience an increase in promotion rate using either a quality screen or a 2P non-retention policy. The non-retention policy has a greater impact on promotion rates.

4. Implementation

While the intent is to compare steady-state results, retention policies do not immediately reach steady state. The annual inventory following a change in policy is calculated using Equation (22), where $\mathbf{n}_t$ is the inventory at time t, and $\mathbf{P}$, R, and $\mathbf{r}$ are as previously defined (Bartholomew, Forbes, & McClean, 1991).

$$\mathbf{n}_t = \mathbf{n}_{t-1}\mathbf{P} + R\mathbf{r} \qquad (22)$$

The differences between the actual and steady-state values immediately following implementation are slight for the quality screen, with only a 0.2 percent difference between the target and actual Staff Sergeant inventories the year immediately following implementation. This shortfall cascades through the higher grades of E7, E8, and E9. For a 20-percent quality screen, the largest shortfall is less than 0.3 percent, as shown in Figure 22.

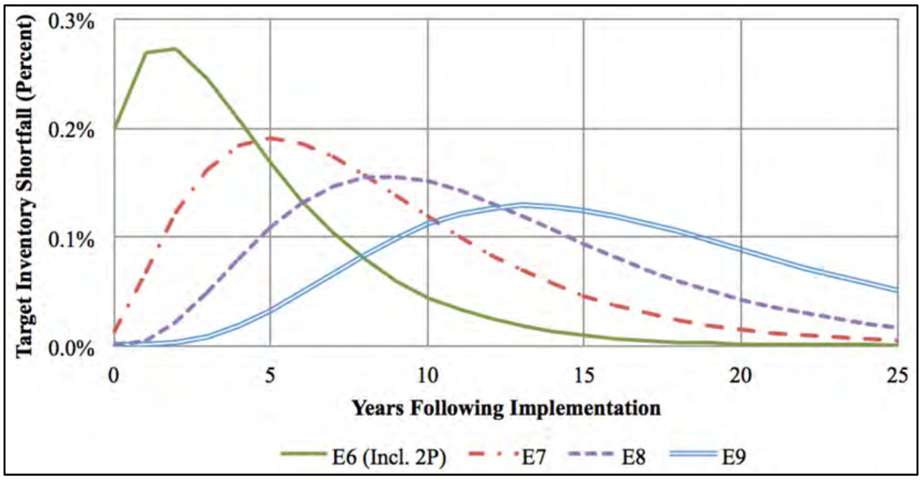


Figure 22. *Target Inventory Shortfalls Following Policy Implementation.* The implementation of a quality screen results in a Staff Sergeant shortfall of less than 0.3 percent.

For a non-retention policy, the systematic change is more significant than for a quality screen, resulting in greater inventory shortfalls following implementation. For the non-retention policy, if steady-state promotion rates are used, the attrition of all 2P E6 results in a shortfall of Staff Sergeants from the target inventory, 7.4 percent immediately following implementation. This shortfall is reduced to less than 1 percent after the year 6 of the policy; however, the shortfall cascades through the higher grades of E7, E8, and E9. It takes more than 15 years for the E8 shortfall and more than 20 years for the E9 shortfall to drop below 1 percent, as shown in Figure 23. In a promote-to-vacancy system, the initial shortfall and subsequent cascade effect is addressed by increasing the initial promotion rate above the steady-state value to fill the vacancies. These shortfalls could also be mitigated through a more gradual implementation of the policy, which would lessen the shock to the system during the years immediately following implementation.

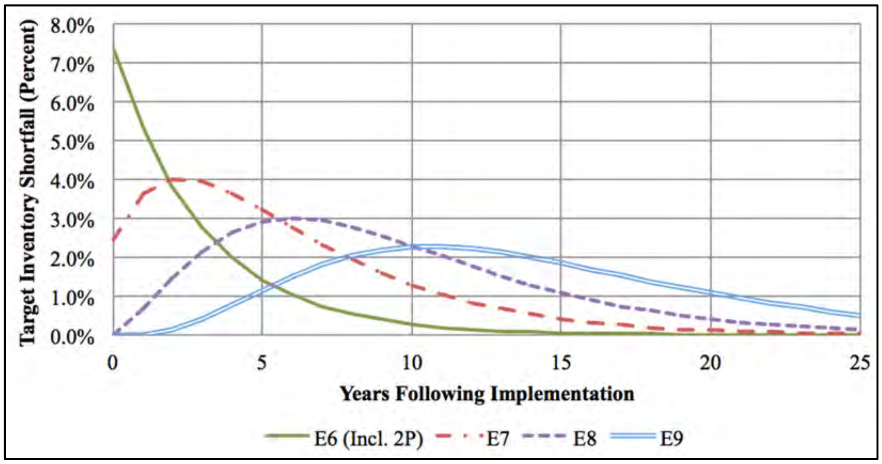


Figure 23. *Target Inventory Shortfalls During Non-Retention Policy Implementation*. Immediately following implementation, there is a 7.4 percent shortfall in Staff Sergeants. This shortfall cascades through the higher ranks for more than 20 years before reaching a steady-state inventory.

D. SUMMARY

If the objective is to reduce the number of 2P Staff Sergeants in the inventory, a policy that targets 2P Staff Sergeants, such as the non-retention policy, is significantly more effective than one that targets re-enlistees. A quality screen is less effective at reducing the number of 2P Staff Sergeants, due to the difficulty in projecting which Staff Sergeants will reach the 2P E6 state. However, if the objective is to reduce the percentage of Staff Sergeant who reach the 2P E6 state, a quality screen is more effective at identifying low performers than a first-come, first-serve reenlistment process. Both policies increase the promotion rates for junior grades and require a small increase in the number of recruits. Although it is not modeled here, a combination of these policies may prove to be the most effective at reducing the impact of 2P Staff Sergeants on the enlisted force. Chapter VII investigates the institutional cost associated with these alternatives.

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VII. SIMULATION: INSTITUTIONAL COST OF 2P RETENTION

In much of the debate surrounding the retention of 2P Staff Sergeants, the focus is on fairness to the individual; whereas, there is a lack of discussion on the impact of 2P Staff Sergeants on the Marine Corps as an institution. Three areas are considered in which 2P Staff Sergeants have an institutional cost: productivity loss, excess subordinate attrition, and retirement obligations. In the base case, a 2P Staff Sergeant inventory of 2,384 results in estimated productivity losses of $2{,}770 \pm 50$ FTEs, excess subordinate attrition of 339 ± 6 Marines, and retirement obligations with a present value of $\$122.3 \pm \$0.2$ million on an annual basis. These results provide an order of magnitude estimate of the institutional costs associated with the retention of 2P Staff Sergeants. The base-case institutional costs are evaluated against a 20-percent quality screen and a non-retention policy to determine potential savings.

A. LEADERSHIP EFFECTS AND PRODUCTIVITY LOSS

Productivity loss resulting from 2P Staff Sergeant retention is simulated as a function of individual leadership effect, which is a supervisor's impact on unit performance or productivity. As introduced in Chapter II, existing literature reveals leadership effects varying from 4 to 40 percent across a range of industries (Goodall & Pogrebna, 2015). Although there is no attempt to determine the actual leadership effect of Staff Sergeants within the Marine Corps, estimates of leadership effect are used to develop an order of magnitude assessment for 2P unit productivity loss.

Assuming Staff Sergeant performance is normally distributed, leadership effects are simulated for the total inventory of 15,168 Staff Sergeants using a random normal distribution with a mean of zero and a standard deviation of 15 percent. The result is an inventory in which the average Staff Sergeant has a baseline leadership effect of zero, a below-average Staff Sergeant has a negative leadership effect, and an above average Staff Sergeant has a positive leadership effect. With a standard deviation of 15 percent, Staff Sergeants in the bottom five percent of performers are almost 25 percent less productive than the average Staff Sergeant, corresponding to a leadership effect of –0.247. This distribution is generated for a single run of the simulation in Figure 24. A total of 10,000 replications are completed for each simulation.

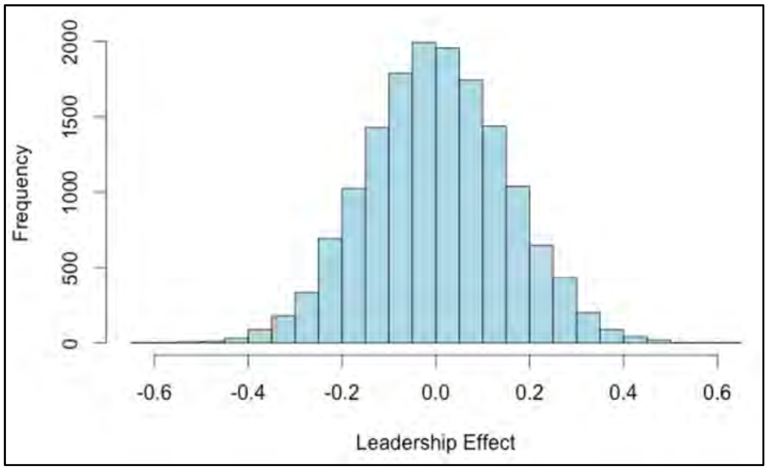

Figure 24. *Sample Leadership Effects with 15-Percent Standard Deviation Simulated For 15,168 Staff Sergeants*. Leadership effects are simulated using a normal distribution with a mean of zero. Using a 15-percent standard deviation, the best and worst performers would have approximately a 50 percent increase or decrease in team productivity, respectively.

This analysis assumes the average team size is the same for 2P and non-2P Staff Sergeants. Based on the pyramidal structure of the 2017PP GAR, each Staff Sergeant supervises an average of 4.5 junior Marines (E1–E3), 2.5 Corporals (E4), and 1.7 Sergeants (E5), which is an average team size of 9.7 including the Staff Sergeant. Using this assumption, 2P Staff Sergeants supervise more than 20,500 Marines, as shown in Figure 25.

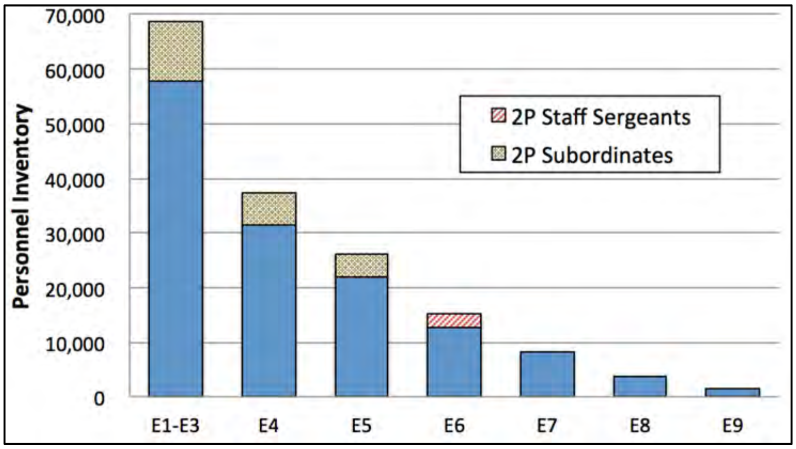

Figure 25. *Illustration of 2P Staff Sergeants and Subordinates for the Base Case.* 2P Staff Sergeants will have a proportional impact on the rest of the chain of command. In the base case, this includes more than 20,500 junior Marines and Non-Commissioned Officers based on 2017PP GAR target inventories.

The average Staff Sergeant is assumed to get 40 man-hours of productivity from each member of his or her team each week. The leadership effect of zero corresponds to 388 man-hours of weekly productivity for an average team size of 9.7 Marines. Unit productivity loss for an individual Staff Sergeant, $productivityLoss_i$, is calculated using Equation (23), where $leadershipEffect_i$ is the individual leadership effect and $teamProductivity_{ave}$ is the average team productivity in man-hours for all Staff Sergeants.

$$productivityLoss_i = -leadershipEffect_i * teamProductivity_{ave} \tag{23}$$

Evaluating the relative performance of 2P Staff Sergeants compared to the rest of the inventory of Staff Sergeant is a challenge. The inventory includes newly promoted Staff Sergeants, as well as Staff Sergeants who attrite prior to promotion eligibility, whose long-term performance is difficult to determine. The initial assessment of productivity loss uses conservative assumptions of 15-percent standard deviation in leadership effects and below-average performance from 2P Staff Sergeant relative to the full inventory. To simulate below-average performance, leadership effects for each 2P Staff Sergeant are randomly selected from the lower half of the previously simulated leadership effects for the inventory. Unit productivity loss is calculated for all simulated

2P Staff Sergeants. The result is an average 2P productivity loss of 46.5 man-hours per week with a standard deviation of 0.8 man-hours, as shown in Figure 26.

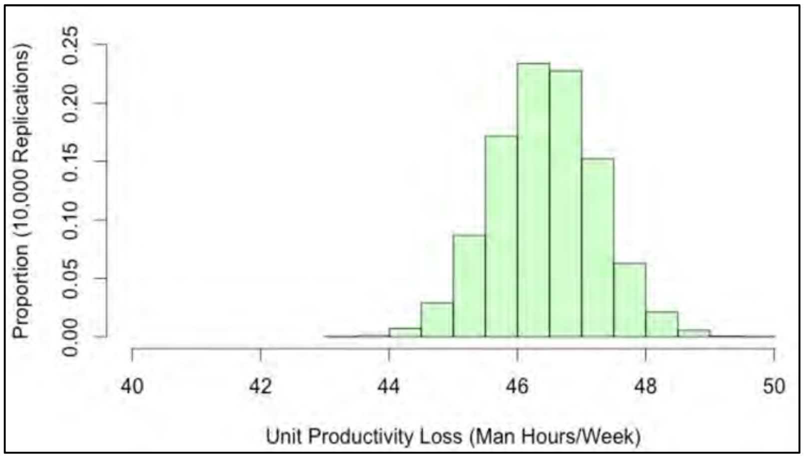

Figure 26. *Average Unit Productivity Loss Per 2P Staff Sergeant*. Assuming below-average performance from 2P Staff Sergeants and 15-percent standard deviation in the leadership effect, each 2P Staff Sergeant causes an average of 46.5 ± 0.8 man-hours of productivity loss per week.

1. Sensitivity Analysis

There is no available data on the actual impact that a Staff Sergeant has on unit productivity, so any measure of productivity loss is subject to variation based on the assumed deviation among leadership effects. A small standard deviation suggests either similar performance among Staff Sergeants. As the standard deviation increases, a Staff Sergeant's impact on the performance of his or her unit increases. A sensitivity analysis of standard deviations reflects the impact of this assumption on unit productivity loss per 2P Staff Sergeants, as shown in Figure 27. Average unit productivity loss varies from 15.5 ± 0.3 man-hours per week to 77 ± 1 man-hours per week, based on the assumed standard deviation of the leadership effect.

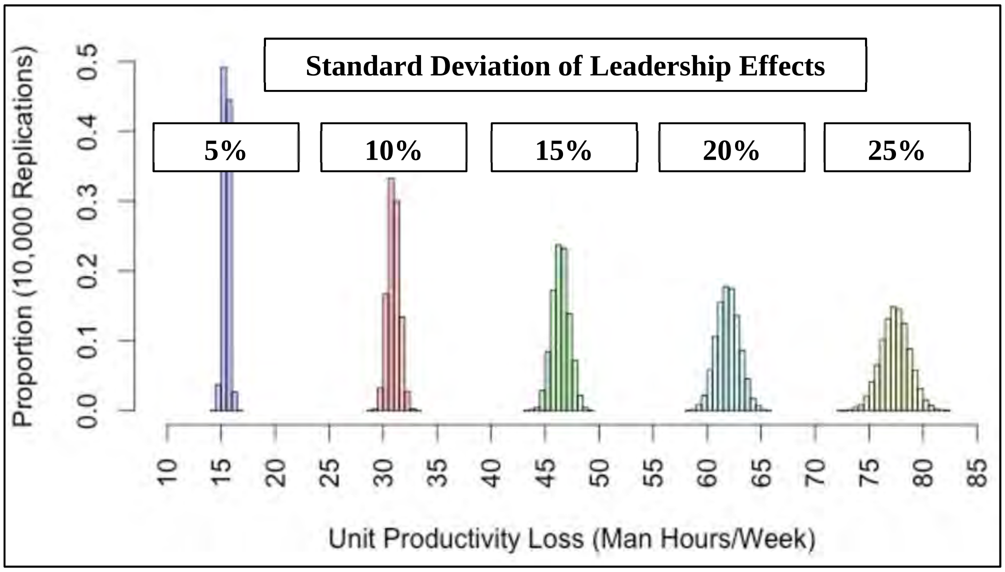

Figure 27. *Histograms of Average Unit Productivity Loss Per 2P Staff Sergeant For Variable Leadership Effects*. As the variance in leadership effects among Staff Sergeants increases, the productivity loss for units led by 2P Staff Sergeants increases. 2P Staff Sergeant performance is assumed to be below average relative to the performance of the total Staff Sergeant inventory. Leadership effects for all Staff Sergeants are modeled for 10,000 replications.

It is likely that 2P Staff Sergeant performance is frequently in the bottom third of Staff Sergeants. The worst-case scenario is that 2P Staff Sergeants are actually the lowest performers in the inventory. Using a 15-percent standard deviation for the leadership effect, a sensitivity analysis is conducted assuming below average, bottom third, and lowest performance for the relative performance of 2P Staff Sergeants, as shown in Figure 28. Average unit productivity loss varies from 46.5 ± 0.8 man-hours per week to 89.1 ± 0.8 man-hours per week, based on assumed relative performance.

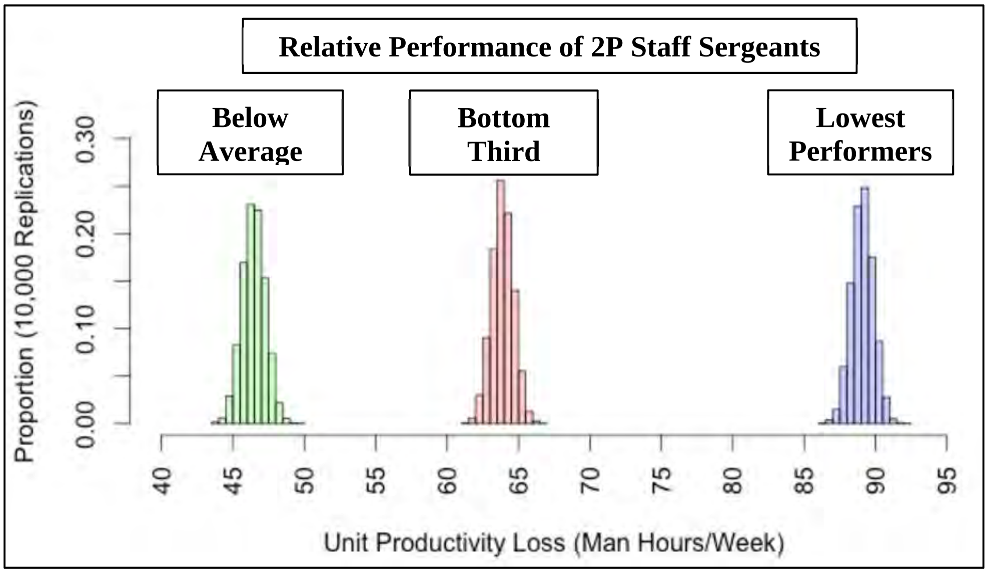

Figure 28. *Histograms of Average Unit Productivity Loss Per 2P Staff Sergeant For Variable Performance Relative To All Staff Sergeants*. As the relative performance of a 2P Staff Sergeant decreases, the productivity loss for units led by 2P Staff Sergeants increases. Leadership effects for all Staff Sergeants are modeled as ~N(0,0.15) for 10,000 replications.

2. Potential Savings

It is possible to calculate potential savings in terms of productivity loss using the reduction in steady-state inventory of 2P Staff Sergeants from the policy alternatives identified in Chapter VI. Using the base-case policy, over the course of a 52-week year, 2P Staff Sergeants cost the Marine Corps 5.7 ± 0.1 million man-hours, which is the same as $2{,}770 \pm 50$ full-time equivalents (FTEs). Again, this is assuming 15-percent standard deviation in leadership effect and below-average performance for 2P Staff Sergeants. Using a 20-percent quality screen, productivity loss is reduced to $2{,}510 \pm 40$ FTEs. For a non-retention policy, productivity loss is reduced to $1{,}120 \pm 20$ FTEs, as shown in Figure 29.

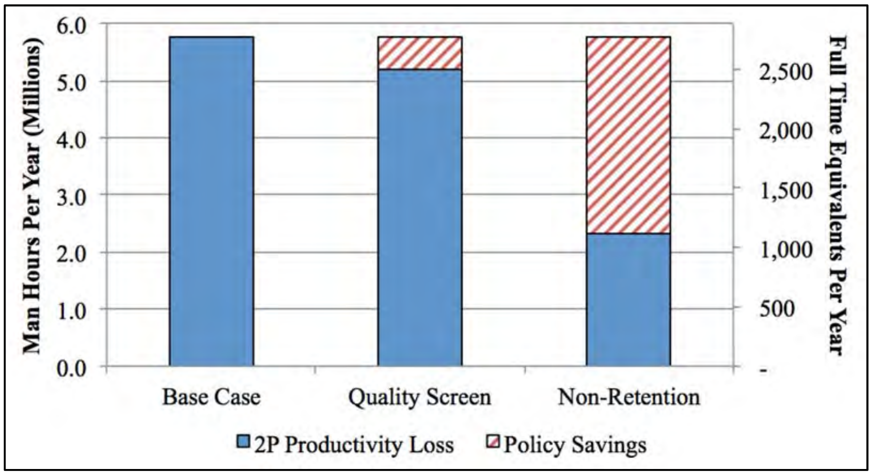

Figure 29. *Annual Productivity Loss Associated With 2P Staff Sergeants Across Policy Alternatives*. A non-retention policy saves 1,650 FTEs of productivity over the base case, compared to 260 FTEs for a 20-percent quality screen. Leadership effects for all Staff Sergeants are modeled as ~N(0,0.15) for 10,000 replications.

B. TURNOVER HAZARD AND EXCESS ATTRITION

Using the same assumptions regarding the number of Marines supervised by 2P Staff Sergeants, an average team size of 9.7 Marines is also used when discussing attrition. For this analysis, the attrition of 2P Staff Sergeants is not considered, only of their direct subordinates. Excess subordinate attrition resulting from 2P Staff Sergeant retention is simulated as a function of individual turnover hazard, which is a supervisor's impact on subordinate retention. As introduced in Chapter II, one study identifies a turnover hazard with 12 percent standard deviation among supervisors (Lazear, Shaw, & Stanton, 2012). Although there is no attempt to determine the actual turnover hazard of Staff Sergeants within the Marine Corps, a standard deviation of 10 percent in turnover hazard is used with the average attrition rates to develop an order of magnitude assessment for 2P subordinate attrition. As determined in Chapter V, the average annual attrition probability for grades E1 through E5 is 0.20 ± 0.01; this is used to model turnover hazard.

Again, assuming Staff Sergeant performance is normally distributed, turnover hazards are simulated for the entire inventory of Staff Sergeants using a random normal distribution with a mean of 0.20 and a standard deviation of 0.10. The result is an inventory where the average Staff Sergeant has a turnover hazard of 0.20, representing the average attrition rate of a subordinate, and a below-average Staff Sergeant has a higher than average turnover hazard. With a standard deviation of 10 percent, a Staff Sergeant in the bottom 5 percent of performers has a turnover hazard of 0.23, equivalent to a 23 percent probability of attrition per subordinate. This turnover hazard is 16 percent higher than the average Staff Sergeant; this distribution is generated for a single run of the simulation in Figure 30. A total of 10,000 replications are completed for each simulation.

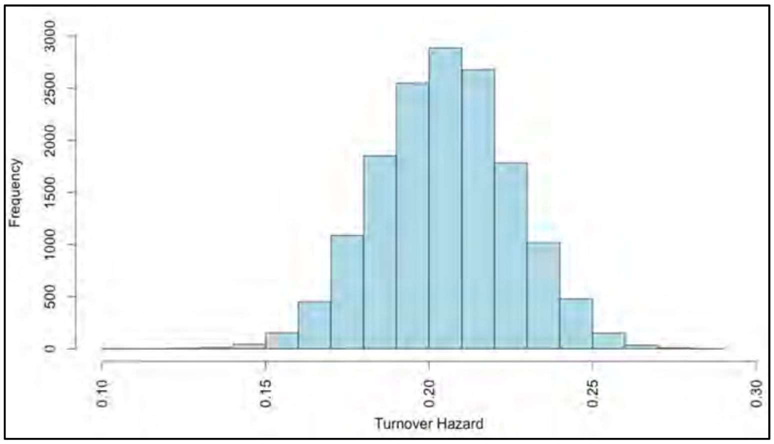

Figure 30. *Sample Turnover Hazard with 10-Percent Standard Deviation Simulated For 15,168 Staff Sergeants*. Turnover hazard is simulated using a normal distribution with a mean of 0.20. Using a 10-percent standard deviation, the best and worst performers would have approximately a 35 percent increase or decrease in subordinate attrition, respectively.

The leadership effect of 0.20 corresponds to expected attrition of 1.7 subordinates annually for a Staff Sergeant with an average team size of 9.7 Marines. Excess subordinate attrition for an individual Staff Sergeant, $excessAttrition_i$, is calculated using Equation (24), where $turnoverHazard_i$ is the individual turnover hazard, $turnoverHazard_{ave}$ is the average turnover hazard, and $teamSize$ is the average team size for all Staff Sergeants.

$$excessAttrition_i = \left(turnoverHazard_i - turnoverHazard_{ave}\right) * teamSize \qquad (24)$$

The initial assessment of excess attrition uses conservative assumptions of 10-percent standard deviation in turnover hazard and below-average performance from 2P Staff Sergeant relative to the full inventory. To simulate below-average performance, attrition hazards for each 2P Staff Sergeant are randomly selected from the lower half of the previously simulated attrition hazards for the inventory. Excess subordinate attrition is calculated for all simulated 2P Staff Sergeants. The result is an increase in expected subordinate attrition of 0.142 ± 0.003 Marines per 2P Staff Sergeant. Using the base-case policy, total excess subordinate attrition for all 2P Staff Sergeants averages 339 Marines annually with a standard deviation of six Marines, as shown in Figure 31.

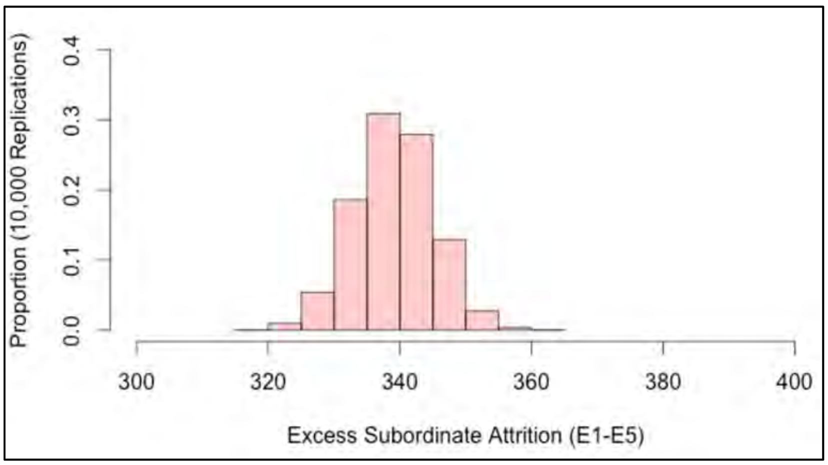

Figure 31. *Average Excess Subordinate Attrition from 2P Staff Sergeants Annually in the Base Case*. Assuming below-average performance from 2P Staff Sergeants and 10-percent standard deviation in the turnover hazard, 2P Staff Sergeants cause excess attrition of 339 ± 6 subordinates annually compared to average expected attrition.

1. Sensitivity Analysis

There is no available data on the actual impact that a Staff Sergeant has on unit attrition, so any measure of subordinate attrition is subject to variation based on the assumed deviation in turnover hazard. A small standard deviation suggests similar subordinate retention among Staff Sergeants. Conversely, a large standard deviation suggests that Staff Sergeants have a direct and significant impact on subordinate retention. A sensitivity analysis of standard deviations reflects the impact of this assumption on excess subordinate attrition, as shown in Figure 32. Using the base-case policy, excess subordinate attrition varies from 170 ± 3 Marines to 508 ± 9 Marines annually, based on the assumed standard deviation of the turnover hazard.

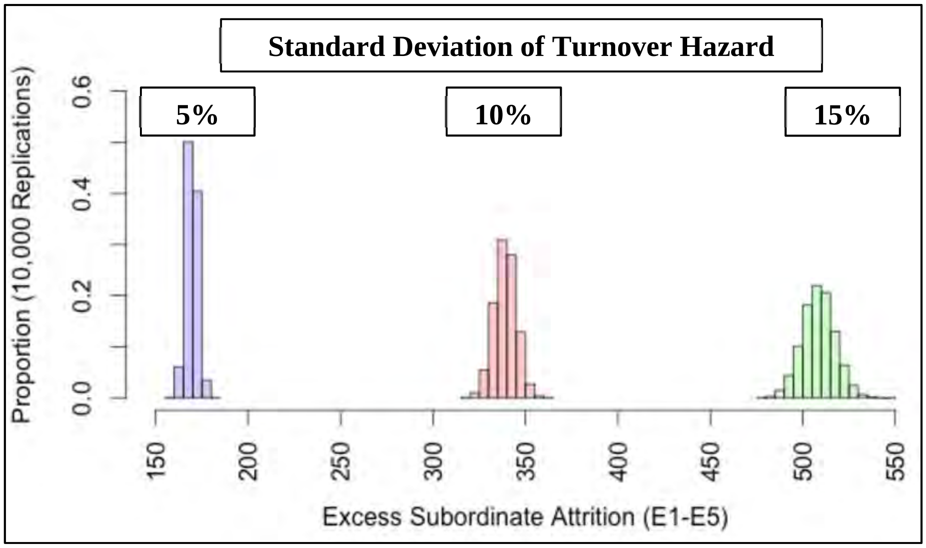

Figure 32. *Histograms of Excess Subordinate Attrition Attributable to 2P Staff Sergeants in the Base Case for Variable Turnover Hazards*. As the variance in turnover hazard among Staff Sergeants increases, attrition for 2P subordinates increases. 2P Staff Sergeant performance is assumed to be below average relative to the total Staff Sergeant inventory.

As with the evaluation of productivity loss, assuming that 2P Staff Sergeants have below-average performance is a conservative assumption. Using a 10-percent standard deviation in turnover hazard, a sensitivity analysis is conducted assuming below average, bottom third, and lowest performance for the relative performance of 2P Staff Sergeants, as shown in Figure 33. In the base case, excess subordinate attrition varies from 339 ± 6 Marines annually to 650 ± 6 Marines annually, based on assumed relative performance. This accounts for roughly 1 to 2 percent of annual Marine Corps attrition.

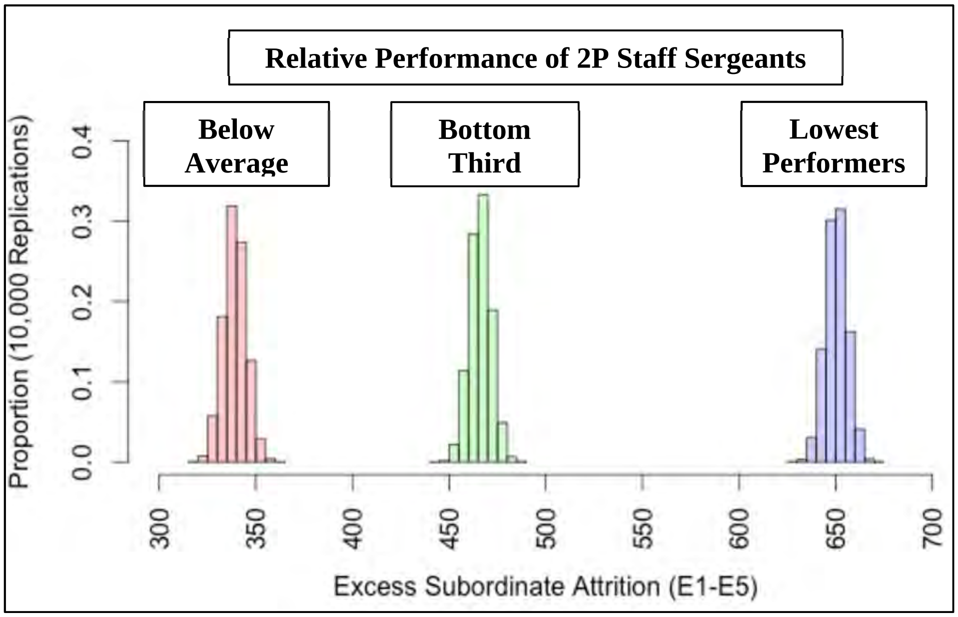

Figure 33. *Histograms of Increased Attrition Attributable to 2P Staff Sergeants in the Base Case for Variable Performance Relative to All Staff Sergeants*. As the relative performance of a 2P Staff Sergeant decreases, attrition for 2P subordinates increases. Turnover hazard for all Staff Sergeants are modeled as ~N(0,0.10) for 10,000 replications.

2. Potential Savings

It is possible to calculate potential savings in terms of excess subordinate attrition using the reduction in steady-state inventory of 2P Staff Sergeants from policy alternatives identified in Chapter VI. Assuming a 10-percent standard deviation in turnover hazard and below-average performance for 2P Staff Sergeants, excess subordinate attrition due to 2P Staff Sergeants is 339 ± 6 Marines, roughly 1 percent of the required number of recruits each year. Using a 20-percent quality screen, excess subordinate attrition is reduced to 307 ± 5 Marines. For a non-retention policy, excess subordinate attrition is reduced to 136 ± 2 Marines, as shown in Figure 34.

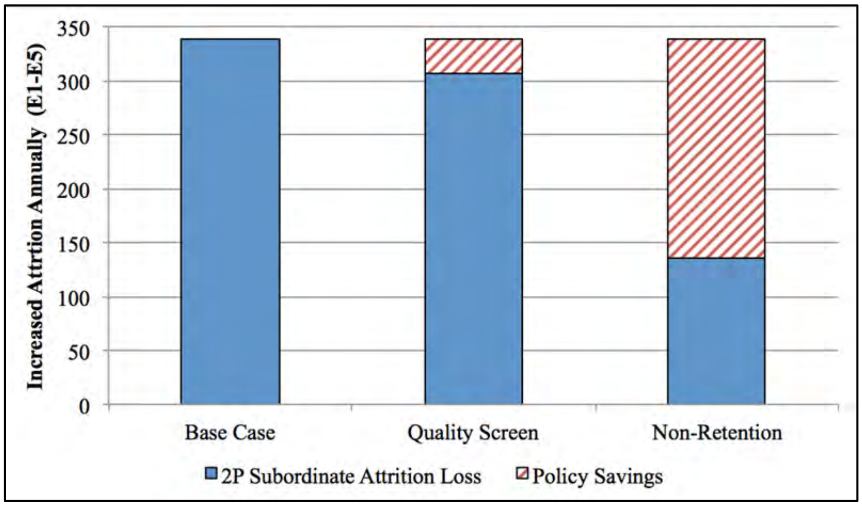

Figure 34. *Annual Attrition Loss Associated With 2P Staff Sergeants Across Policy Alternatives*. A non-retention policy reduces attrition by 203 Marines over the base case, compared to a reduction of 32 Marines for a 20-percent quality screen. 2P Staff Sergeants are assumed to be below-average performers and the turnover hazard has a 10-percent standard deviation.

C. RETIREMENT OBLIGATIONS

The present value of retirement obligations are modeled by treating a military pension as a fixed-income annuity using Equation (25), where *PV* is the present value of the pension, PMT_{annual} is the annual pension payment, *r* is the discount rate, and *longevity* is the expected number of years of payment.

$$PV = PMT_{Annual} \frac{\left(1-(1+r)^{-longevity}\right)}{r} \tag{25}$$

This is a conservative first-order approximation, as it does not include the cost of living adjustment for retirees. This analysis also excludes the cost of other retiree benefits, such as healthcare or commissary benefits.

Longevity is modeled as a normal distribution with a mean of 44 years and standard deviation of 5 years, assuming the average 2P Staff Sergeant retires at age 38 and lives to age 82. The average present value of a retirement is calculated at various discount rates for a retiring 2P cohort using a randomly generated longevity for each retiring Marine, 358 Staff Sergeants for the base case. A standard deviation is determined using 10,000 iterations. The retirement benefit for a Staff Sergeant retiring after 20 years of service is 50 percent of his or her base pay, amounting to $1,862.10 per month for 2015 (Under Secretary of Defense, Personnel & Readiness, 2015, n.d.). At a 6-percent discount rate, the average present value of a 2P Staff Sergeant retirement is $341,900 with a standard deviation of $500. The estimated present value of retirement obligations incurred each year for retiring 2P Staff Sergeants under the base-case, quality screen, and non-retention policies is shown in Figure 35.

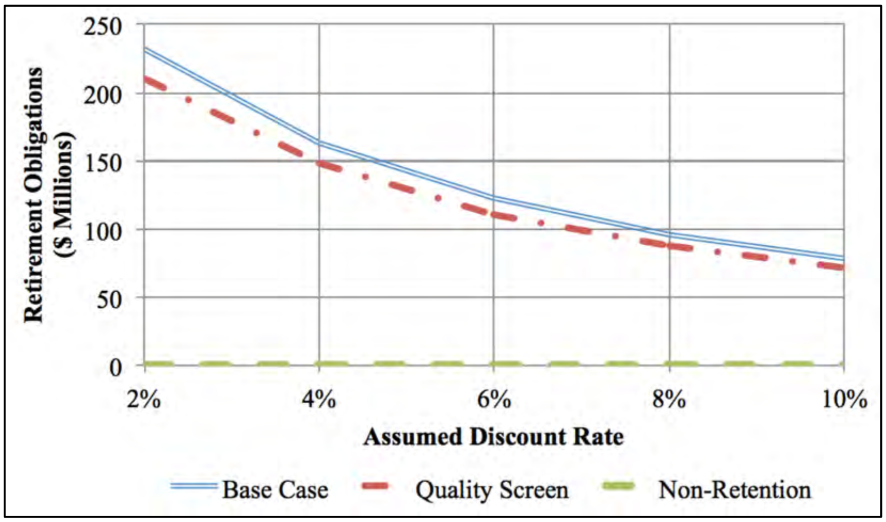

Figure 35. *Mean Present Value Of 2P Staff Sergeant Retirement Obligations Incurred Annually*. At a 6-percent discount rate, 2P Staff Sergeant retirement obligations have a present value of more than $122 million for the base case and $110 million for a 20-percent quality screen. A non-retention policy does not result in any retirement obligations for 2P Staff Sergeants.

D. SUMMARY

Given the institutional costs of productivity loss, excess subordinate attrition, and retirement obligations, it is clear that considerations for 2P Staff Sergeant retention should consider more than the individual Marine. The most significant limitation is the lack of research surrounding the leadership effects and turnover hazards within the Marine Corps; however, existing research from external industries provides a basis for analysis. In the base case, a 2P Staff Sergeant inventory of 2,384 results in estimated productivity losses of 2,770 $\pm$ 50 FTEs, excess subordinate attrition of 339 $\pm$ 6 Marines, and retirement obligations with a present value of \$122.3 $\pm$ \$0.2 million on an annual basis. A 20-percent quality screen results in an estimated increase in productivity of 260 FTEs, reduction in attrition of 32 Marines, and a reduction in retirement obligations of \$11.6 million on an annual basis. Comparatively, a non-retention policy results in an estimated increase in productivity of 1,650 FTEs, reduction in attrition of 203 Marines on an annual basis, and zero retirement obligations. These results provide an order of magnitude estimate of the institutional costs associated with the retention of 2P Staff Sergeants. Although these estimates are simulated using a number of assumptions, they represent potentially significant recurring costs that can be reduced through the use of identified retention policies.

VIII. CONCLUSIONS AND RECOMMENDATIONS

This thesis shows that retention policy can effectively increase promotion rates and reduce the institutional cost associated with the retention of 2P Staff Sergeants. Reenlistment provides an opportunity to evaluate the quality of the force; however, if the objective is a reduction in 2P Staff Sergeants, there is a high error rate associated with a quality screen. Markov models provide valuable insight into the impact of retention policies on the enlisted personnel system. Finally, the institutional costs associated with the retention of low performers can be substantial. These considerations must be weighed against the "fairness" of denying a Marine further service following more than a decade of service.

> What we've always known is that the way we recruit, develop, retain, and promote Sailors and Marines is critical to our success. To fight and win in this century we need a force that draws from the broadest talent pools, values health and fitness, attracts and retains innovative thinkers, provides flexible career paths, and prioritizes merit over tenure. Whether we are talking about systems and tactics in the digital age or personnel management, we must evolve to meet the needs of the future battle space and the needs of our people; or we can—we will—lose. (Mabus, 2015)

A. PREDICTORS OF 2P LIKELIHOOD

The use of logistic regression to determine predictors of 2P likelihood provides insight into the Marine Corps evaluation and promotion process. The misclassification rate of the logistic regression is high, at 33 percent, but there are still strong indicators of quality that exist, which should influence retention decisions. Enhancements to this model may be possible with the availability of fitness report data; however, it is unclear whether this would improve the classification rate. Reenlistment cohorts are established based on TIS, which creates large variances in TIG and the amount of observable data at the rank of Staff Sergeant. The differences in observation time as a Staff Sergeant make direct comparisons between Marines difficult. For these reasons, evaluating 2P likelihood at the time of Zone C reenlistment is likely to continue to exhibit a high rate of misclassification. However, quality should still be a primary consideration in retention decisions, and this model provides indicators of quality to assist in evaluating individual Marines.

The positive indicators of 2P likelihood are low PFT score, commander’s recommendation, MCMAP belt, and AFQT score. PFT score is the most important variable in terms of response variability, suggesting that the difference between a high and low PFT score is significant even at higher enlisted ranks. A commander’s recommendation of “Not-Recommended” or “Recommended with Reservation” should carry more weight than a positive recommendation in determine retention decisions and serve as a significant red flag. MCMAP belt is also a significant indicator of performance and can be viewed as a proxy for intangible traits. It is not possible from this data to determine whether advancing through the MCMAP program makes a better Marine or better Marines advance farther through the MCMAP program. AFQT score is also significant, though less so than the other identified variables.

Several binary characteristics also indicate higher 2P likelihood: adverse material, black racial identification, and being outside of height and weight regulations. Adverse material in grade, with an 11.4 odds-ratio, is significantly more important than adverse material prior to reaching the rank of Staff Sergeant, and should be heavily weighted in any retention decision. There does appear to be a racial bias in evaluating 2P likelihood; Marines with a black racial identifier have 1.5 times the odds of 2P outcomes compared to all other racial identifiers. This is particularly concerning and should be investigated further to determine whether changes are necessary to Marine Corps evaluation and promotion systems. Finally, being above the maximum weight for their height increases a Marine’s 2P likelihood.

B. RETENTION POLICY ALTERNATIVES

Implementation of the base-case, quality screen, and non-retention policies in the Markov model provides a comparison of annual promotion rates as a percent of the total inventory for that grade, and average TIG for each rank. There is a slight increase in the promotion rate for E1 through E5 as the number of 2P E6 in the system is reduced. The largest decrease in average TIG is for Staff Sergeants, which is reduced from 4.4 years in the base case to 4.0 years for the quality screen and 3.8 years for the non-retention policy. A comparison of steady-state inventories from the three policy alternatives reveals a reduction in 2P E6 inventory, while maintaining the target inventory of total Staff Sergeants. A 20-percent quality screen reduces 2P Staff Sergeant inventory by 9.4 percent and a non-retention policy reduces 2P Staff Sergeant inventory by 59.7 percent.

If the objective is to reduce the inventory of 2P Staff Sergeants, a non-retention policy is significantly more effective than a quality screen at reenlistment, due to the difficulty in determining 2P likelihood. However, in the case of slow-promoting MOS, a limit on the number of approved reenlistments, known as boat spaces, can reduce the proportion of Staff Sergeants who are eventually twice-passed for promotion by using a quality screen. Although the developed quality screen has a high misclassification rate, it can inform the human decision makers. Both policies were shown to increase annual promotion rates, though the non-retention policy has a larger impact. The value of using Markov models is that the system can model varying amounts of detail and produce steady-state results to compare policy alternatives.

C. INSTITUTIONAL COSTS

Institutional costs of productivity loss, excess subordinate attrition, and retirement obligations make it clear that considerations for 2P Staff Sergeant retention should address more than the impact on the individual Marine. Unit productivity loss due to 2P Staff Sergeants and leadership effects may range from less than 20 man-hours to greater than 85 man-hours per week, based on sensitivity to relative performance and standard deviation in leadership effect. Assuming a 15-percent standard deviation and below-average performance of 2P Staff Sergeants, $2{,}770 \pm 50$ FTEs are lost each year due to 2P retention. Productivity loss is reduced to approximately 2,510 or 1,120 FTEs for a quality screen or non-retention policy, respectively. Productivity loss is frequently overlooked as an institutional cost of retaining low performers. A better understanding of leadership effects and their impacts is necessary.

In addition to productivity loss, excess subordinate attrition may range from less than 200 to greater than 600 Marines annually, based on sensitivity to relative performance and standard deviation in turnover hazard. Assuming a 10-percent standard deviation and below-average performance of 2P Staff Sergeants, there is excess attrition of 339 ± 6 Marine subordinates each year due to 2P Staff Sergeant retention. Excess attrition is reduced to approximately 310 Marines or 140 Marines for the quality screen and non-retention policy, respectively. Finally, the present value of retirement obligations due to 2P Staff Sergeant retention are conservatively modeled as fixed income annuities, where a quality screen has a proportional reduction in retirement obligations to the reduction in 2P Staff Sergeants, from $122.3 $\pm$ 0.2 million to approximately $110 million. A non-retention policy incurs no retirement obligations. The estimated institutional costs associated with each policy alternative are shown in Table 17.

Table 17. *Estimated Institutional Costs Incurred Annually Due to 2P Staff Sergeant Retention.*

	2P Staff Sergeant Inventory	Retirement Obligations	Lost Productivity	Excess Attrition
Base Case	2,380	$120 M	2,770 FTEs	340 Marines
20% Quality Screen	2,160	$110 M	2,510 FTEs	310 Marines
Non-Retention	960	$ 0 M	1,120 FTEs	140 Marines

Although these estimates are simulated using a number of assumptions, they represent potentially significant recurring costs that can be reduced through the use of identified retention policies. The results of this study also show that targeted retention policies can have a direct impact on improving promotion tempo and should supplement current promotion policies as a means of ensuring quality in the enlisted force.

D. RECOMMENDATIONS

This thesis evaluates enlisted retention in aggregate; however, it is recommended that the impact of retention policies be evaluated for each MOS, as the desired results for fast-promoting and slow-promoting MOS is different. For slow-promoting MOS, reducing retention of 2P Staff Sergeants and limiting the number of approved reenlistments could result in the desired increase in the rate of promotions. Likewise, an increase in retention of Marines in fast-promoting MOS will result in the desired decrease in the rate of promotions. The existing policy of variable selection opportunity for fast-promoting and slow-promoting MOS artificially inflates or deflates the average TIS for promotion by expanding or contracting promotion zones. By definition, variable selection opportunity does not provide for equal promotion opportunity across all MOS. Instead, Marines in slow-promoting MOS face more competition on each board.

The results of this thesis suggest that an alternative way to meet target TIS to promotion is through retention policy. Slow-promoting MOS will be disproportionally impacted during the implementation phase of a 2P Staff Sergeant Retention Policy because a larger proportion of eligible Marines in these MOS are passed each year, but these same MOS have the most to gain from this type of policy implementation. A reduction in 2P Staff Sergeants will effectively increase promotion rates and upward mobility. In addition, the use of boat spaces, which already limit the number of approved reenlistments for FTAP Marines, could help stabilize retention rates between years and MOS. This will have a positive impact on reducing the number of slow-promoting MPP and will reduce the number of Marines passed for promotion by increasing selection opportunity for the Marines on any given board.

Though not considered in this analysis, additional policies targeting Marines in fast-promoting MOS for increased retention of the best and most highly qualified would allow for the appropriate level of competition on each promotion board, without retaining and promoting low-quality Marines for the sake of meeting target requirements. Retention policy, not promotion opportunity, is the appropriate avenue to address concerns regarding target promotion tempo. The current Staff Sergeant Retention Boards offer a limited version of the non-retention policy and should be evaluated as a long-term solution for 2P Staff Sergeant retention.

E. FUTURE WORK

There is tremendous potential for additional work surrounding Marine quality and the impact of quality on unit performance and subordinates; however, data management within the Marine Corps makes that a challenge. Fitness report data is maintained separately from other personnel records and reenlistment data is maintained in an isolated system. Currently, there is limited record of a Marine's enlisted chain of command throughout his or her career, making a study of leadership effects difficult. Despite data management challenges, the value of understanding leadership impacts within the Marine Corps could have significant institutional benefits. One of the major limitations in this analysis is the lack of data on the actual leadership impact and turnover hazard associated with Staff Sergeants in the Marine Corps. Although the impact of turnover hazard was relatively small across the range of standard deviations, the impact of leadership effect is likely to be quite significant, perhaps more so than indicated by studies from other industries. The actual institutional cost of retaining poor performers at any rank is unknown and represents a blind spot in the current manpower decision-making process.

APPENDIX A. 1994 DECISION BRIEF: PHASE II OF MARINE CORPS TRANSITION TO ENLISTED "UP OR OUT" RETENTION / PROMOTION POLICY

1000
MPP-24
23 Jun 94

DECISION BRIEF

Subj: PHASE II OF MARINE CORPS TRANSITION TO ENLISTED "UP OR OUT " RETENTION/PROMOTION POLICY

1. **Purpose**. To obtain a decision on the implementation of the subject policy.

2. **Background**.

a. During the 1980's the Marine Corps retained and promoted our enlisted Marines at a rate that was not consistent with our manpower requirements. The result was a steadily increasing Time In Service (TIS)/Time In Grade (TIG) to promotion caused by an overage of Marines in the career force. The problem grew so serious that by 1991, a new recruit entering the Marine Corps would take 30 years to reach MGySgt.

b. On 18 Nov 91, the Commandant was briefed on a series of proposals designed to help match our inventory of Marines with our requirements. The proposals, known as "Up or Out" consisted of the following:

1. Decreasing promotion opportunity by 10% for all grades.
2. Instituting flexible promotion opportunity (varying opportunity by MOS in order to speed up or slow down promotion flow and thereby create consistency in TIS/TIG across the Marine Corps at all grades).
3. Creating a formal Above Zone to ensure new Marines get looked at for promotion each year.
4. Separation at EAS for twice passed (2P) Sgts.
5. Separation of 2P SSgts at the time of their second selection failure.
6. Separation at EAS for 2P GySgts after 20 years of service (YOS).
7. Separation at EAS for 2P 1stSgts/MSgts after 22 YOS.

c. Proposals one through four, six and seven were approved and are now in place. They have made substantial improvements in lowering TIS/TIG and creating consistency by MOS. However, proposal five was never implemented due to concern of breaking faith with our Marines by separating them before EAS. An additional concern was changing the policy that allows SSgts to reach retirement eligibility as long as they meet retention standards.

Figure 36. *1994 Up-Or-Out Decision Brief (Page 1 of 4).* Implements an "Up Or Out" policy for 2P Staff Sergeants, signed by General Carl E. Mundy Jr., CMC (from MPP-20, p. 1).

3. **Current Situation.**

a. Separation of 2P SSgts is a vital part of the "Up or Out" policy. The formal Above Zone and flexible promotion opportunity improve TIS/TIG by "forcing" Marines into the Promotion Zone to compete for available promotion allocations. As noted earlier, 2P Marines are moved out of the inventory at all grades except E-6. Since promotion allocations are determined by an inventory shortfall when compared to the MOS requirement, each 2P SSgt reduces E-6 promotion allocations by one.

b. Since the implementation of "Up or Out", TIS/TIG for promotion has decreased for all ranks except SSgt, where it has actually increased:

	E-4	E-5	E-6	E-7	E-8	E-9
FY92	2.07	2.98	5.18	6.30	6.84	5.19
FY93	1.90	2.59	5.45	6.08	6.43	5.04

c. Total number of 2P SSgts currently in the inventory is 1,212. If these 1,212 SSgts were removed from the inventory, we would immediately promote 3,636 Marines (LCpl through Sgt) to fill the vacancies that would be created.

d. Approximately 485 additional 2P SSgts will be created after the 1994 E-6 Board. We project that only 300 2P SSgts will retire.

e. Currently, there are 147 MOSs with 2P SSgts in the inventory. Of those 147 MOSs, 132 (90%) have Sgts with 11 or more YOS who are approaching High Year Tenure (HYT).

f. 30 MOSs are projected to have zero allocations on the 1994 E-6 Board. The majority of those 30 MOSs do not have allocations due to poor grade structure, which we are working to correct, or due to structure decreases. However, some are affected by 2P SSgts in the inventory. For instance, MOS 6152 would go from zero to ten allocations if 2P SSgts were not in the inventory. MOS 1161 would go from zero to five.

g. The Variable Separation Incentive (VSI)/Special Separation Benefit (SSB), which has been our only tool to reduce the number of 2P SSgts in the inventory, is unfunded after 1995. Additionally, the program is voluntary, and therefore it only makes a dent in the problem.

h. If promotion to SSgt remains a stumbling block, our NCOs will continue to suffer from slow promotions. Retention of our best and brightest first term Marines will grow increasingly difficult as they evaluate their career opportunities inside the Corps. We have already seen a 3% reduction in our careerist (YOS 5 -20) continuation rates.

Figure 37. *1994 Up-Or-Out Decision Brief (Page 2 of 4).* Implements an "Up Or Out" policy for 2P Staff Sergeants, signed by General Carl E. Mundy Jr., CMC (from MPP-20, p. 2).

4. **Recommended Course of Action.**

a. We recommend the completion of the "Up or Out" program by implementing the separation of 2P SSgts with the following conditions:

1. 2P SSgts separated at EAS.
2. 18 YOS (completed) sanctuary; in other words, 2P SSgts who complete 18 YOS before their EAS stay until 20 years.
3. Current inventory of 2P SSgts with more than 16 YOS would be "grandfathered" and allowed to stay until 20 Years. In effect, all SSgts will go into the 1995 GySgt Board with a "clean slate" as far as this policy is concerned. Those SSgts who fail selection for the second time in 1996, and who do not have 18 completed YOS by their EAS, would be the first Marines affected.

b. **Advantages**:

1. Removes all 2P SSgts from the inventory, thereby creating increased promotion flow for LCpls, Cpls, and Sgts.
2. Will help retention of best first term Marines (Marines have a higher propensity to reenlist when they hit EAS at a higher rank).
3. Consistent with separation policy for 2P E-5s, E-7s, and E-8s.
4. Provides SSgts two chances for promotion at a standard selection opportunity of 75% (3 of 4 SSgts still get selected for GySgt).
5. Grandfathering allows time for Marines to plan.
6. Avoids breaking contracts.
7. Does not require SecNav plenary authority to establish new basis for enlisted separation.
8. Provides the average 2P SSgt with separations Pay in excess of $30,000.

c. **Disadvantages**:

1. 400 to 500 2P SSgts will be separated annually (based on current promotion allocations to sustain a 174,000 Marine Corps). This causes an "up front" annual cost of approximately $14 million to pay for increases in Separations Pay and PCS. However, this cost could be off-set by longevity savings in our Pay and Allowances Account caused by increased promotion tempo. Eventually, the Marine Corps could realize annual cost savings up to $70 million if we realize our Ideal Force targets.
2. Allows "protection" to 20 years for some SSgts based solely on EAS timing. Will subside as contract lengths are managed consistent with expectations of when Marines will be considered for promotion.
3. We stand alone; no other service is taking similar actions to manage their forces.
4. Requires a temporary accession increase to maintain end strength. However, this accession increase is small (400), and will not take effect until FY97, when QMA is climbing again.

Figure 38. *1994 Up-Or-Out Decision Brief (Page 3 of 4).* Implements an “Up Or Out” policy for 2P Staff Sergeants, signed by General Carl E. Mundy Jr., CMC (from MPP-20, p. 3).

5. **Summary**. It is instinctive for us to protect our Marines. Therefore, it seems natural to allow SSgts to retire after 20 YOS. However, we do not believe that we can protect our Marines if by doing so we hurt our Corps. In essence, that is what is happening by retaining 2P SSgts. While we protect a small group of Marines who have had two opportunities to be fairly evaluated for promotion by 36 of their fellow Marines, we are hindering a much larger group from having the same opportunity in a timely manner. Separation of our less competitive Marines in order to make room for our "hard chargers" is the right thing to do.

	Approval	Disapproval
Director, MP Recommends	6/28	______
Director, MM Recommends	6/23	______
ADC/S, M&RA Recommends	Approved 6/29/94	______
DC/S, M&RA Recommends	6/29/94	______
SgtMajMarCor Recommends	5 Jul 94	______
ACMC Recommends	______	______
CMC Decision	[signature]	______

Figure 39. *1994 Up-Or-Out Decision Brief (Page 4 of 4).* Implements an "Up Or Out" policy for 2P Staff Sergeants, signed by General Carl E. Mundy Jr., CMC (from MPP-20, p. 4).

APPENDIX B. ARCHIVED CORRESPONDENCE REGARDING 2P STAFF SERGEANT RETENTION POLICY (1994–1999)

DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
WASHINGTON, D.C. 20380-0001

IN REPLY REFER TO:
1000
MPP-24
21 JUL 1994

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE NAVY (MANPOWER AND RESERVE AFFAIRS)

Subj: MARINE CORPS "UP OR OUT" PROMOTION/RETENTION POLICY

1. On 30 June 1994, the Commandant of the Marine Corps approved the "Up Or Out" promotion/retention policy for staff sergeants (SSgts) who fail selection to gunnery sergeant (GySgt) two times. The following conditions apply:

a. Twice passed (2P) SSgts will be separated at the time of their expiration of active service (EAS).

b. An 18 year of service (YOS) sanctuary will apply; in other words, 2P SSgts who complete 18 YOS before their EAS will remain retirement eligible so long as they maintain retention standards.

c. The current inventory of 2P SSgts with more than 16 YOS will be "grandfathered" and allowed to reach retirement eligibility.

d. This policy will be announced at the end of this fiscal year, but it will not take effect until the 1995 GySgt Board, which will meet in July 1995. All SSgts will go into the 1995 GySgt Board with a "clean slate." Those SSgts who fail selection for the second time in 1996, and do not have 18 completed YOS, will be the first Marines affected.

e. The average SSgt separated under this policy will be eligible for separation pay in excess of $30,000.

2. The Marine Corps already separates 2P Marines at all grades that promote by competitive boards, except SSgt. Since our promotion allocations are determined by an inventory shortfall when compared to the MOS requirement, each 2P SSgt reduces E-6 promotion allocations by one. This creates a "promotion bottleneck" at the grade of E-5. This bottleneck is impeding our ability to maintain timely promotions and therefore is contributing to retention problems of our best and brightest first term Marines. The bottom line is that for every 2P SSgt that is separated, three Marines (lance corporal through sergeant) will be promoted to fill the vacancies that are created. We believe that separating Marines who are not competitive for promotion is the best way to strengthen the quality of our enlisted force.

Figure 40. *1994 LtGen Christmas Memorandum to Mr. Pang (Page 1 of 2).* LtGen George R. Christmas, Deputy Chief of Staff for M&RA, memorandum for Frederick F. Y. Pang, Assistant Secretary of the Navy (M&RA), outlining the approved Marine Corps "Up-Or-Out" policy (from Christmas, 1994, p. 1).

Subj: MARINE CORPS "UP OR OUT" PROMOTION/RETENTION POLICY

3. My staff is prepared to brief you if you desire additional information.

G.R. Christmas

G. R. CHRISTMAS
Deputy Chief of Staff for
Manpower and Reserve Affairs

2

Figure 41. *1994 LtGen Christmas Memorandum to Mr. Pang (Page 2 of 2)*. LtGen George R. Christmas, Deputy Chief of Staff for M&RA, memorandum for Frederick F. Y. Pang, Assistant Secretary of the Navy (M&RA), outlining the approved Marine Corps "Up-Or-Out" policy (from Christmas, 1994, p. 2).

DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
2 NAVY ANNEX
WASHINGTON, DC 20380-1775

IN REPLY REFER TO

5320
MPP-25
26 OCT 1995

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE NAVY (MANPOWER AND RESERVE AFFAIRS)

Subj: TWICE PASSED (2P) STAFF SERGEANT (SSGT) POLICY

1. You have requested that the Marine Corps consider offering a "transition period" that provides separating 2P SSgts more compensation than involuntary separation pay. The discussion below summarizes the findings of my staff after a thorough evaluation of your proposal. This information compliments that which was discussed during our previous "rounds."

2. Per your specific request, we estimate the following year of service (YOS) distribution of 2P SSgts by fiscal year:[1]

Table 1. Number of 2P SSgts Projected to Be Separated by YOS and FY

YOS	FY97	FY98	FY99	FY00
8	0	0	0	1
9	0	1	1	2
10	1	3	4	7
11	2	10	16	22
12	1	36	39	42
13	9	50	48	50
14	21	46	55	63
15	64	83	89	92
16	137	128	101	87
17	218	60	47	34
TOTAL	453	418	402	400

3. Currently, Marines separated under the 2P SSgt policy will receive involuntary separation pay. The projected funding stream[2] for separation pay by fiscal year is:

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1 Table 1 reflects YOS distribution as of 1 Oct 96. We estimate there are 119 Marines with an EAS prior to 1 Oct 96 who, if not extended for sufficient transition time, may not reach the 18 YOS sanctuary. These 119 Marines are not reflected in the total for FY97 of 453.

2 All funding streams reflect Marines in the 18 YOS sanctuary continuing to retirement eligibility and not being offered an other early out benefit.

Figure 42. *1995 LtGen Christmas Memorandum to Dr. Rostker (Page 1 of 4).* LtGen George R. Christmas, Deputy Chief of Staff for M&RA, memorandum for Bernard D. Rostker, Assistant Secretary of the Navy (M&RA), addressing expressed concerns about compensation for separated 2P Staff Sergeants (from Christmas, 1995, p. 1).

SUBJ: TWICE PASSED (2P) STAFF SERGEANT (SSGT) POLICY

	FY97	FY98	FY99
Separation Pay	$17.4M	$14.9M	$14.5M

4. Temporary Early Retirement Authority (TERA) and Variable Separation Incentive/Special Separation Bonus (VSI/SSB) are authorized by Congress through FY99 as drawdown tools. If supported by Congress, these tools could be used to provide additional compensation to 2P SSgts during a transition period.

a. Because TERA is for Marines with more than 15 YOS, Marines with less than 15 YOS would receive involuntary separation pay. The projected funding stream for TERA for 2P SSgts with 15-18 YOS and involuntary separation pay for 2P SSgts with less than 15 YOS, by fiscal year is:

	FY97	FY98	FY99
Early Retirement	$14.1M	$10.2M	$9.3M
Separation Pay	1.1M	4.4M	5.0M
Total	$15.2M	$14.6M	$14.3M

b. The projected funding stream for VSI/SSB for 2P SSgts with less than 18 YOS by fiscal year is (assumes all 2P SSgts would take VSI/SSB, with a 35% take rate for VSI):

	FY97	FY98	FY99
VSI/SSB*	$18.5M	$15.9M	$15.4M

* This estimate will be substantially higher once the full amount is determined by the actuary.

5. We have discussed many of the following arguments for implementing the current policy as planned during our previous "rounds." However, I believe that it is important to restate them and draw a conclusion.

a. ALMAR 267-94 announced the change to "Up or Out" Promotion/Retention policy on 7 Sep 94. The policy included a "grandfather" clause to ensure every Marine who may be subject to this policy receives two opportunities to be selected for promotion prior to separation.

b. The standard opportunity for promotion to gunnery sergeant (GySgt) is 75%. Historically, about 16% of Marines who have been passed at least once are selected to GySgt.

c. Adamantly supported by the senior enlisted leadership of the Corps.

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Figure 43. *1995 LtGen Christmas Memorandum to Dr. Rostker (Page 2 of 4).* LtGen George R. Christmas, Deputy Chief of Staff for M&RA, memorandum for Bernard D. Rostker, Assistant Secretary of the Navy (M&RA), addressing expressed concerns about compensation for separated 2P Staff Sergeants (from Christmas, 1995, p. 2).

SUBJ: TWICE PASSED (2P) STAFF SERGEANT (SSGT) POLICY

d. Marines separated under this policy will receive involuntary separation pay that will exceed $30,000.

e. Offering TERA and/or VSI/SSB during a "transition period" must be tied with Congressionally authorized force reduction policies. The Marine Corps was "marked" for budgeting funds for a FY95 VSI/SSB Program. The Congress stated that since the Marine Corps is no longer downsizing, we should not be using drawdown tools. Hence, we were not authorized to offer a VSI/SSB Program after FY94.

f. Concerns of "breaking an implied contract" with SSgts (once promoted to SSgt, a Marine can continue to retirement eligibility) are not addressed by a transition period. Drawdown tools (TERA, VSI/SSB) are authorized through FY99. Hence, any transition benefit tied to the 2P SSgt policy will end in FY99. All Marines who were promoted to SSgt prior to the implementation of a 2P SSgt policy will not be covered by the transition period.

g. Early retirement or VSI/SSB may be perceived as inequitable since Marines who are selected for promotion are not offered these options. Many Marines, including many promoted to GySgt, would like early retirement and VSI/SSB. If these programs are only offered to those who fail selection to GySgt, it may be perceived that we are "rewarding" those found to be not as competitive as their peers for promotion.

h. Any benefit offered during the transition period involving TERA penalizes Marines in fast promoting MOSs. TERA is restricted to Marines with more than 15 YOS. Marines in fast promoting MOSs are more likely to be 2P with less than 15 YOS than Marines in slow promoting MOSs.

i. Based on promotion timing and equivalent levels of supervision, a 2P SSgt equates to a 2P Captain. Captains not selected for promotion are provided involuntary separation pay.

j. The military is often criticized for what is generally viewed as an "overly generous" retirement system. Providing an early retirement or other generous separation incentive to Marines with less than 20 YOS, who have not stayed competitive with their contemporaries, may add to the criticism.

k. All Marines separated under this policy will be given sufficient transition time, along with their involuntary separation pay, to prepare for civilian life.

i. The Marine Corps already adheres to the 18 YOS sanctuary for retirement eligibility. We must establish a policy with

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Figure 44. *1995 LtGen Christmas Memorandum to Dr. Rostker (Page 3 of 4).* LtGen George R. Christmas, Deputy Chief of Staff for M&RA, memorandum for Bernard D. Rostker, Assistant Secretary of the Navy (M&RA), addressing expressed concerns about compensation for separated 2P Staff Sergeants (from Christmas, 1995, p. 3).

SUBJ: TWICE PASSED (2P) STAFF SERGEANT (SSGT) POLICY

discernible qualifications or we run the risk of "whittling away" the intent of the policy. If we implement a transition period, do we establish "new sanctuary" of 14 years, 11 months as being eligible for early retirement vice separation pay? If the transition period ends on 1 Jun, do we establish a "sanctuary" so Marines scheduled to separate within three months after 1 Jun are in the "sanctuary" and can receive the additional benefits?

6. As you know, I feel strongly about this program. It is the right thing for the Marine Corps as we balance our force after the drawdown while ensuring the opportunity for all our Marines to rise to the highest grade their potential will take them. This program ensures that equal opportunity by opening the way to higher ranks for junior Marine noncommissioned officers whose promotion opportunity is currently thwarted. It has been enacted fairly and is accepted throughout the Corps. There is no expectation of a retirement benefit except separation pay. The "transition period" and reimbursement you suggest is not equitable and simply sends the wrong message. Accordingly, I can not accept it as a "fix" to the current policy. Recognizing that you must now take our disagreement to the Secretary and Under Secretary of the Navy, I will inform the Commandant and Assistant Commandant of our discussions and impasse. I truly believe that our program, approved by your predecessor, should continue in its current form.

G.R. Christmas

G. R. CHRISTMAS
Deputy Chief of Staff for
Manpower and Reserve Affairs

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Figure 45. *1995 LtGen Christmas Memorandum to Dr. Rostker (Page 4 of 4).* LtGen George R. Christmas, Deputy Chief of Staff for M&RA, memorandum for Bernard D. Rostker, Assistant Secretary of the Navy (M&RA), addressing expressed concerns about compensation for separated 2P Staff Sergeants (from Christmas, 1995, p. 4).

THE ASSISTANT SECRETARY OF THE NAVY
(MANPOWER AND RESERVE AFFAIRS)

January 20, 1996

MEMORANDUM for Deputy Chief of Staff (Manpower and Reserve Affairs)

SUBJ: Marine Corps Policy on Twice Passed Staff Sergeants

As we discussed on the phone, the Under Secretary and I had an informal discussion about the 2P policy. Besides generally reviewing the equity argument, we asked (1) if the 2P policy would, in fact catch only poor performers, given that promotions are vacancy driven, MOS by MOS, and (2) if we might more equitably reach our goal of freeing up the promotion system by instituting a continuation board at the 14th year of service. As noted below, the 14th year is where sanctuary kicks in for officers.

Below are the arguments that, from my viewpoint, summarize my equity concerns. In addition, I have enclosed the DMDC data concerning the grade distribution of enlisted Marines in 1995 with 14 years of service. It would be these Marines that would have to stand before the continuation board.

BACKGROUND

Last spring I received a call from a Marine family concerned about the involuntary separation of a Staff Sergeant (SSgt/E-6) with seventeen years of service simple because he had failed on two occasions to be promoted to Gunnery Sergeant (GSgt/E-7). In other words an *enlisted* Marine was being turned out without a pension with seventeen years of service, not because he had done anything wrong, but because, on a relative standard in his MOS, he had not been promoted to the next higher grade. While an up-or-out system has long existed for officers, Congress and DOD policy does not allow for the involuntary separation of officers with 14 or more years of service. Such disparate treatment between officers and enlisted seemed harsh and unfair, and I said I would look into it.

Subsequent to that initial phone call the situation changed for the specific party, but my inquiry resulted in my questioning the new Marine Corps "Twice Passed (2P) Staff Sergeant Policy" on several grounds. Unfortunately, you and I have reached an impasse over the efficacy of the policy itself, and, if the policy stands, how to treat those involuntarily separated.

The 2P Policy

As part of the general drawdown each of the Services has initiated a "high tenure" policy for enlisted personnel. Generally, this has been to separate E-6s who have not been promoted to E-7 when they become retirement eligible at 20 years of service. The Marine Corps 2P policy would separate E-6s before retirement and stands alone as a policy to involuntarily separate career service members before retirement on other than either discipline grounds, or for failure to meet physical standards.

Figure 46. *1996 Dr. Rostker Memorandum to LtGen Christmas (Page 1 of 5).* Bernard D. Rostker, Asst. Secretary of the Navy (M&RA), memorandum to LtGen George R. Christmas, Deputy Chief of Staff, M&RA, concerning equity of the 2P Staff Sergeant retention policy and potential for a 14-year continuation board. Author of handwritten notes unknown (from Lange, 1996, Encl 1, p. 1).

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The Marine Corps brought the twice passed (2P) Staff Sergeant policy to my predecessor as an information only brief on 21 July 1994. It announced a 30 June 1994 decision by the Commandant to initiate an up or out policy for SSgts/E-6. As the Marine Corps saw it, the current system was creating a "promotion bottleneck" at the grade of E-5, and in order to speed up promotions of junior Marines, the Corps was going to send twice passed over SSgts home, with as much as seventeen years of service, with only severance pay to show for their many years with the Marine Corps. The Marine Corps argued that since they, "already separate 2P Marines at all grades that fail to promote by competitive boards, except SSgt," this new policy was just a logical extension of existing policy. They also said that they would maintain an 18 year of service "sanctuary" and that those with more than 16 years of service in 1994 would have a two year "grandfather" period before the policy took place.

The briefing slides that accompanied the memorandum noted that the intent was to standardize promotion tempo as noted in Table 1.

Table 1
Desired Standardized Promotion Points Across All MOSs

Grade	Years of Service Promotion Points
E-5/Sgt	4.5 years
E-6/SSgt	8 years
E-7/GYSgt	12 Years
E-8/1STSgt/MSgt	17 years
E-9/SGTMAJ/MGYSGT	22 years

Concern for Equity

I was initially concerned about fairness of this policy because of the disparate way we would treat officers compared to enlisted personnel when each fail twice to be selected for promotion and the specific policies that would be followed. My concern grew when it became clear that the 2P policy would affect a large number of Marines now and for the indefinite future.

A Large Number Of Marines Will Be Affected By The Policy

The memorandum and briefing presented to Fred Pang emphasized the sanctuary and grandfathering provisions of the new policy. While it was not precise, the move to the above promotion points would be straight forward and rapid, so that there would not be many that would be adversely effected. As I explored the issues, it became clear that (1) the transition from the current promotion points to the new "standardized" promotion points would not be either easy or rapid, and (2) relatively large numbers of enlisted Marines would be separated with a significant number of years of service for some time to come. As a result of reconsidering the issue, your staff provided me with the Table 2 data which shows the projected number of 2P SSgts would remain about 400 per year for, as best as we can tell, the indefinite future.

Figure 47. *1996 Dr. Rostker Memorandum to LtGen Christmas (Page 2 of 5).* Bernard D. Rostker, Asst Secretary of the Navy (M&RA), memorandum to LtGen George R. Christmas, Deputy Chief of Staff, M&RA, concerning equity of the 2P Staff Sergeant retention policy and potential for a 14-year continuation board. Author of handwritten notes unknown (from Lange, 1996, Encl. 1, p. 2).

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Table 2
Number of 2P SSgts Projected to Be Separated by Years of Service (YOS) and Fiscal Year (FY)

YOS	FY97	FY98	FY99	FY00
8	0	0	0	1
9	0	1	1	2
10	1	3	4	7
11	2	10	16	22
12	1	36	39	42
13	9	50	48	50
14	21	46	55	63
15	64	83	89	92
16	137	128	101	87
17	218	60	47	34
TOTAL	453	417	400	400

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Disparate Treatment of Officers and Enlisted Personnel Concerning Involuntary Separation for Promotion Failure

While officers and enlisted personnel are not managed under the same authority, I believe it is important to treat them as similarly as possible when it comes to the perceived fairness of the system. In this regard, the new Marine Corps policy for SSgts is strikingly different from the way we treat officers who fail twice to be selected for the next higher grade *with the same number of years of service.* Given that both systems do not vest until 20 years of service, I believe that the intent of Congress is clear here. Congress formally only legislates the officer management system. The Report of the Committee on Armed Services that accompanied DOPMA noted :

> In the case of majors and lieutenant commanders the bill (DOPMA) would structure the grade table to allow a 70-percent selection opportunity to lieutenant colonel and commander and would provide for continuation boards so that twice-passed-over officers could be considered for continuation until 20 years. It is the committee's strong desire that these officers be continued to 20 years of service as a matter of course; only in unusual circumstances would this authority not be fully utilized.

Department of Defense Directive Number 1320.8 provides the implementing policy for officers. It establishes a 6 year sanctuary as follows:

> Officers serving in the grade of O-4 who are subject to discharge ... shall normally be selected for continuation ... if the officer will qualify for retirement ... within six years. ... The Secretaries of the Military Departments concerned may, in unusual circumstances, discharge involuntarily such officers ... after notifying the Secretary of Defense of the rationale for this action.

Figure 48. *1996 Dr. Rostker Memorandum to LtGen Christmas (Page 3 of 5).* Bernard D. Rostker, Asst. Secretary of the Navy (M&RA), memorandum to LtGen George R. Christmas, Deputy Chief of Staff, M&RA, concerning equity of the 2P Staff Sergeant retention policy and potential for a 14-year continuation board. Author of handwritten notes unknown (from Lange, 1996, Encl. 1, p. 3).

Congress spoke twice again on the issue of involuntary separation of career personnel *for both officers and enlisted personnel* when it set aside the normal severance pay provisions and initiated the Voluntary Separation Incentive and Selective Separation Bonus (VSI/SSB) and later Temporary Early Retirement Authority (TERA) for early -- 15 year of service -- retirements to handle the drawdown. Congress was clearly uncomfortable with forcing out career personnel with only severance pay to show for their many loyal years of service. Thus they offered a separation package that was more in keeping with the benefits one would have received if he or she had been allowed to serve until retirement.

<u>The Substantial Loss Of Benefits That Would Accompany An Involuntary Separation</u>

Involuntary separation of senior personnel is made all the more difficult when you consider the relatively small level of severance pay compared to the value of the foregone pension. As a result, Congress provided several options to more appropriately compensate career personnel for the substantial lose of lifetime income. The Marine Corps considered using both VSI/SSB and TERA (see Tab B), but rejected both because it was an "unprogrammed expense." In fact, as show in Table 3, it would cost the Marine Corps less to give TERA than to pay the also "unprogrammed, " but "must pay," cost of severance pay.

Table 3
Alternative Marine Corps Costs of 2P Separation Policy by Fiscal Year

Policy	FY97	FY98	FY99
Severance Pay	$17.4M(illion)	$14.9M	$14.5M
TERA	$15.2M	$14.6	$14.3
VSI/SSB	$18.5	$15.9	$15.4

In the final analysis the Marine Corps based their rejection of using TERA on the argument that it "may be perceived that we are 'rewarding' those found to be not as competitive as their peers for promotion." This argument needs to be judged against the small cost to the Marine Corps of providing TERA and the very large loss of lifetime benefits to those involuntarily separated under the current 2P policy, as shown in Table 4.

Table 4
Cost and Value of TERA

Year of Service	Cost to Marine Corps: Severance Pay	Cost to Marine Corps: TERA	Present Value of TERA to Separatees
E-6 with 16 YOS	$36,582	$36,708	$211,352
E-7 with 17 YOS	$38,868	$29,125	$223,697

An Alternative Approach

One alternative, suggested by the Under Secretary would be to initiate a Marine Corps wide continuation board at the 14th year point to select those, regardless of MOS, that would be sent home. While this is a little later than the tenure point for officers, e.g., the selection board to O-4, it is keeping with the DOD Directive. Table 5 shows the distribution of Marines by grade at the 14th year point based on the DMDC data I have. This is the group that would come before the board.

Figure 49. *1996 Dr. Rostker Memorandum to LtGen Christmas (Page 4 of 5).* Bernard D. Rostker, Asst. Secretary of the Navy (M&RA), memorandum to LtGen George R. Christmas, Deputy Chief of Staff, M&RA, concerning equity of the 2P Staff Sergeant retention policy and potential for a 14-year continuation board. Author of handwritten notes unknown (from Lange, 1996, Encl. 1, p. 4).

Table5

Distribution of Marines by Grade with 14 Years of Service

YOS	E-1/E-2/E-3	E-4	E-5	E-6	E-7	E-8	E-9
14	15	5	199	2,018	581	0	0

Cont?

As the data indicates the vast majority, 71 percent, of the 14th year group are E-6s. This is the very group that the 2P policy is designed to cull. I think an argument can be made that submarginal performers could be effectively caught by such a board at this point, just as easily as by a promotion board a year or two later. Moreover, a continuation board at this point could (1) fully take into account the "whole Marine" without regard to the specific manning in a given MOS, and (2) would be more equitable, especially in terms of treating enlisted Marines no less favorable than we treat officers.

WHERE DO WE GO FROM HERE

The next step, after you have reviewed the above, is to meet with the Under Secretary. It does seem to me, however, that Richard has a good insight here and that the continuation board approach might meet both of our concerns.

BERNARD ROSTKER

Figure 50. *1996 Dr. Rostker Memorandum to LtGen Christmas (Page 5 of 5).* Bernard D. Rostker, Asst. Secretary of the Navy (M&RA), memorandum to LtGen George R. Christmas, Deputy Chief of Staff, M&RA, concerning equity of the 2P Staff Sergeant retention policy and potential for a 14-year continuation board. Author of handwritten notes unknown (from Lange, 1996, Encl. 1, p. 5).

February 1, 1996

National Security Committee

Washington D.C.

ATTENTION: Mr. John Chapla

SUBJECT: SERVICE LIMITATIONS

Dear Sir,

At the time I enlisted in the United States Marine Corps, I was promised that at the end of twenty years of faithful and honorable service to my country that I would be retired with fifty percent of my active duty pay. It would appear that this has changed for the Marine Corps.

Enclosed is a message dated Sept. 1994 in which the Marine Corps changed its service limitations for staff non-comissioned officers (E-6's). All other branches of service maintain a limitation of twenty years, thus guaranteeing retirement.

In March 1994 I attempted to re-enlist for my last four years of service, upon completion of which, I would be at the end of twenty years. I was denied re-enlistment and only allowed to extend for eighteen months. This extension will expire when I have seventeen years and eight months of completed service. At that time, I will be involuntarily separated as a direct result of the enclosed almar.

I have done nothing to deserve this kind of treatment. I have served my country with honor, loyalty, and devotion for the last seventeen years of my life, and I am having considerable difficulty understanding why these things are changing without a grandfather clause to look out for Marines like myself who are being adversely affected without just cause.

I do not see this as "Taking care of our Own". It is wrong to put Marines like me out on the street at forty years old with no job skills, other than that of an infantryman, no pension, and worst of all, the feeling of inadequacy that goes along with being forced out of a service that I have dedicated my life.

I feel that a solution to this problem would be to give the Marine that is being involuntarily separated at eighteen years retirement with forty-five percent pay and retention of all other benefits such as medical, dental, and commissary. Another possible solution would be to add a grandfather clause to the almar that protects Marines with significant time in service.

If there is anything you can do for me or Marines like me, your help would be greatly appreciated. Semper Fidelis.

MCMWTC Box 4201, Bridgeport, CA 93517

Figure 51. *SSgt Geheb Letter to Congress (Page 1 of 2).* SSgt Kenneth W. Geheb letter to the House Committee on National Security, expressing concern regarding the 2P Staff Sergeant retention policy (from Dornan, 1996, Encl 1, p. 1).

Sincerely,

Kenneth W. Geheb
SSGT, USMC
(619)932-7761 ext.220

Encl:
(1) Marine Corps Almar 267/94

Figure 52. *SSgt Geheb Letter to Congress (Page 2 of 2).* SSgt Kenneth W. Geheb letter to the House Committee on National Security, expressing concern regarding the 2P Staff Sergeant retention policy (from Dornan, 1996, Encl 1, p. 2).

COMMITTEE ON NATIONAL SECURITY

U.S. House of Representatives

Washington, DC 20515–6035

ONE HUNDRED FOURTH CONGRESS

FLOYD D. SPENCE, SOUTH CAROLINA, CHAIRMAN

February 13, 1996

General Charles C. Krulak
Commandant of the Marine Corps
The Pentagon
Washington, D.C. 20380-1775

Dear General Krulak:

I have enclosed a letter from Staff Sergeant Kenneth W. Geheb, USMC, expressing his concern about being forced to separate after his second nonselection for promotion to E-7.

I must confess, I am troubled by this new separation policy for E-6s. I appreciate the morale and motivation problems associated with a sluggish promotion system, but I worry that the Marine Corps' solution to mandate separation will carry a much higher retention penalty with far reaching implications.

Several points come to mind: (1) all the services have maintained over the years, and the Congress has subsequently internalized, the principle that the armed forces must avoid betraying the loyalty of members who have served more than 15 years; (2) there is no question that promotion to E-7 within the Marine Corps is very competitive and that very solid NCOs are often not selected; (3) the Marine Corps will be the only service to force enlisted members out of the military with 14-16 years of service; and (4) not all E-6s in the Marine Corps have the same opportunity to be promoted to E-7.

I for one can't help but believe that young first term Marines will be distressed to see their NCO leader put out with 16 years of service. I wonder if the prospect of faster promotions for themselves will overcome the fear that this could happen to them even though they are good NCOs. I would greatly appreciate your thoughts on this matter.

Sincerely,

Bob

Robert K. Dornan
Chairman
Military Personnel Subcommittee

RKD:mrh

Figure 53. *Representative Dornan Letter to CMC.* Representative Robert K. Dornan, Chairman, Military Personnel Subcommittee, letter to General Charles C. Krulak, CMC, expressing concern regarding the 2P Staff Sergeant policy (from Dornan, 1996, p. 1).

TWS

Sergeant Major
Manpower and Reserve Affairs

Memorandum

Date 23 AUG 99

To: LTGEN KLIMP

Subject: 2P SSGT RETENTION POLICY

Sir,

I HAVE ALWAYS SUPPORTED THE 2P SSGT POLICY. WITHOUT IT, ENLISTED MARINES ARE <u>NOT</u> RECEIVING "EQUAL TREATMENT". I BELIEVE IMPLEMENTING A 2P SSGT POLICY IS IN THE BEST INTEREST OF THE MARINE CORPS AND WILL STRENGTHEN THE QUALITY OF OUR ENLISTED FORCE BY ENSURING THE OPPORTUNITY FOR TIMELY PROMOTION. (TIMELY PROMOTION OPPORTUNITY IS NECESSARY TO RETAIN OUR BEST AND BRIGHTEST MARINES, HOLDING ON TO SSGTS WHO FAILED SELECTION IS HAVING A NEGATIVE IMPACT ON PROMOTION TIMING AND PROMOTION OPPORTUNITY FOR JUNIOR MARINES. (COULD BE A REASON WHY THERE IS A PROBLEM WITH RENTENTION FOR

Figure 54. *Memorandum Advocating for the Separation of 2P Staff Sergeants with Fewer than 18 Years TIS (Page 1 of 2).* SgtMaj Mark Ouellette, Sergeant Major, M&RA, memorandum to LtGen Jack W. Klimp, Deputy Chief of Staff, M&RA (from Ouellette, 1999, p. 1).

INTERMEDIATE (6-10 YOS) MARINES.)

YES SIR, WE DID TRY THIS BEFORE. WHA STOPPED IT WAS;

— 2P SSGTS SOUNDED OFF TO CONGRESS.

— DR ROSTKER QUESTIONED THE NEED FOR THE POLICY.

- QUESTION WAS ASKED, SHOULD WE BE HOLDIN OUR ENLISTED MARINES TO A STANDARD THA WE DON'T HOLD OUR OFFICERS TO? AT THE TIME (NOT SURE ABOUT NOW), CAPTS WHO FAILED PROMOTION TO MAJ, MOST DID SO AT THE 14 YEAR MARK. WE DO NOT SEPARATE THEM. They are 2P at 11 year mark now and must go. Less than 10 former enlisted officers have 15 or more years [illegible]

AT THE SAME SYMPOSIUM, [illegible] SGTMA SAID, "2P SSGTS SHOULD BE SEPARATED IF THEY HAVE NOT REACHED 18 YRS".

THE CORPS HAS 1,097 2P SSGTS ON THE ROLLS NOW. THEY ARE BETWEEN 9 & 17 YOS. IF WE HAD A 2P SSGT RULE AND ALL 1,097 SSGT WERE SEPARATED, 3,291 JUNIOR MARINES WOULD BE PROMOTED. THINK OF THE IMPACT THAT WOULD HAVE ON PROMOTION TIMING.

SgtMaj Ouellette

Figure 55. *Memorandum Advocating for the Separation of 2P Staff Sergeants with Fewer than 18 Years TIS (Page 2 of 2).* SgtMaj Mark Ouellette, Sergeant Major, M&RA, memorandum to LtGen Jack W. Klimp, Deputy Chief of Staff, M&RA (from Ouellette, 1999, p. 2).

APPENDIX C. MOS CATEGORIES

Table 18. *MOS Category by Occupational Field.* Observations sorted by occupational field and MOS.

MOS Category	Occupational Field Code	Occupational Field	Count	Percent of Total
Administration	01	Personnel & Administration	537	6.6%
Aviation Maintenance	59	Electronics Maintenance	78	1.0%
	60	Aircraft Maintenance	335	4.1%
	61	Helicopter Mechanic	417	5.1%
	62	Fixed-Wing Mechanic	257	3.2%
Aviation Support	63	Organizational Avionics	232	2.8%
	64	Intermediate Avionics	169	2.1%
	65	Aviation Ordnance	141	1.7%
	66	Aviation Logistics	137	1.7%
	68	Meteorological & Oceanographic	23	0.3%
	70	Airfield Services	141	1.7%
	72	Air Support	112	1.4%
	73	Flight Crew	26	0.3%
Combat Arms (Other Than Infantry)	08	Artillery	212	2.6%
	13	Engineer	365	4.5%
	18	Tanks & Amphibious Assault Vehicles	137	1.7%
Communications	06	Communications	709	8.7%
	28	Data / Communications Maintenance	293	3.6%
Infantry	03	Infantry	919	11.3%
Intelligence	02	Intelligence	247	3.0%
	26	Signals Intelligence	103	1.3%
Logistics	04	Logistics	240	2.9%
	11	Utilities	118	1.4%
	21	Ground Ordnance Maintenance	203	2.5%
	33	Food Service	154	1.9%
	35	Motor Transport	607	7.4%
Supply / Ammunition	23	Ammunition	177	2.2%
	30	Supply Administration	423	5.2%
	31	Distribution Management	32	0.4%
	34	Financial Management	71	0.9%

MOS Category	Occupational Field Code	Occupational Field	Count	Percent of Total
Other	05	Plans	20	0.2%
	41	Morale, Welfare, and Recreation	16	0.1%
	43	Public Affairs	19	0.2%
	44	Legal Services	38	0.5%
	46	Combat Camera	31	0.4%
	48	Retention	30	0.4%
	55	Music	67	0.8%
	57	Chemical, Biological, Radiological, & Nuclear	47	0.6%
	58	Military Police	237	2.9%
	84	Recruiting	31	0.4%
Grand Total			**8,151**	**100%**

APPENDIX D. UNIVARIATE ANALYSIS FOR NON-SELECTED VARIABLES

A. FISCAL YEAR

Table 19. *Observations by Fiscal Year*. There are fewer observations in the final sample from FY10 and FY11 due to a higher number of indeterminate observations in these fiscal years.

	FY07	**FY08**	**FY09**	**FY10**	**FY11**
Observations	1,708	2,059	1,802	1,417	1,165

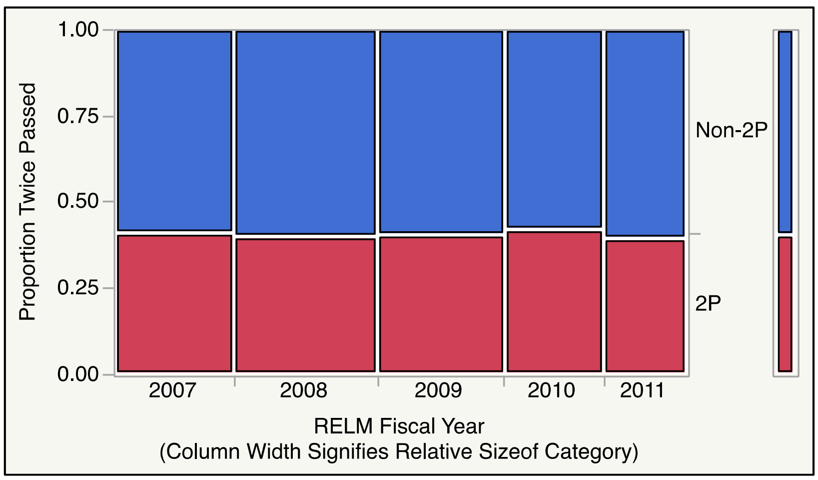

Figure 56. *Mosaic Plot of Staff Sergeants Twice-Passed (2P) by RELM Fiscal Year*. FY10 has the highest proportion of Staff Sergeants twice-passed and FY11 has the lowest proportion (Likelihood Ratio Chi-Squared = 2; p-value = 0.75).

B. MOS CATEGORY

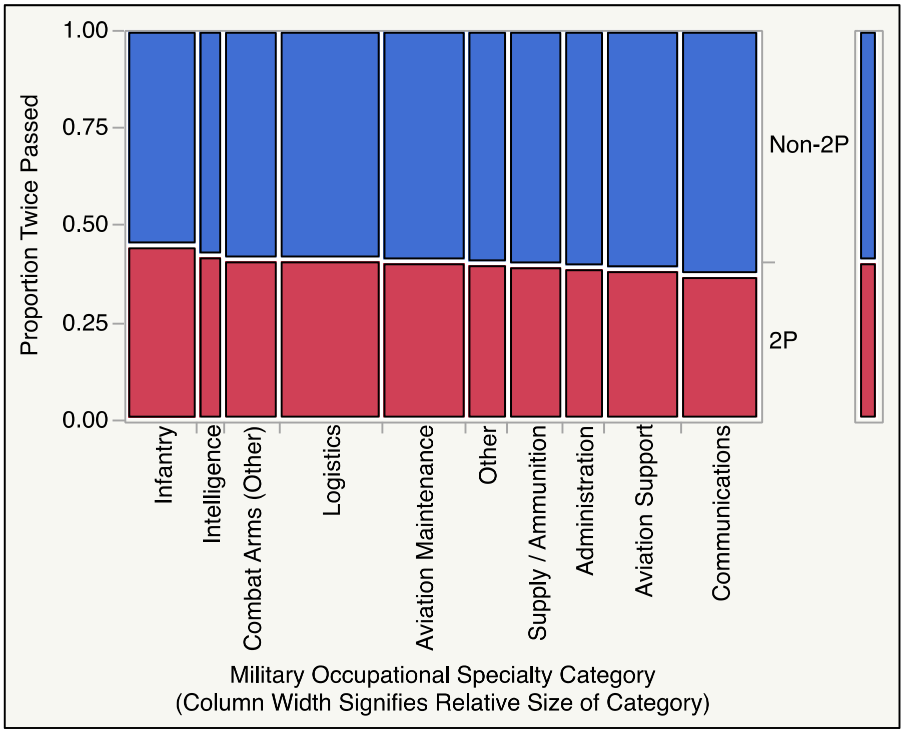

Figure 57. *Mosaic Plot of Staff Sergeants Twice-Passed (2P) by MOS Category.* Infantry has the highest proportion of Staff Sergeants twice-passed and Communications has the lowest proportion (Likelihood Ratio Chi-Squared = 16; p-value = 0.07)

C. RIFLE AND PISTOL QUALIFICATION

Rifle and pistol qualifications are not retained within TFRS, so these data fields are pulled from TFDW using the last score before a Marine's pre-reenlistment EAS. Rifle and pistol qualification scoring changed between FY07 and FY11, so qualification was treated as an ordinal value from 0 to 3, Unqualified to Expert. Those Marines listed as "Not Required" for rifle (seven observations) or pistol (eight observations) are given a Qual value of 3 - Sharpshooter. The univariate analysis is shown in Figure 58 and Figure 59.

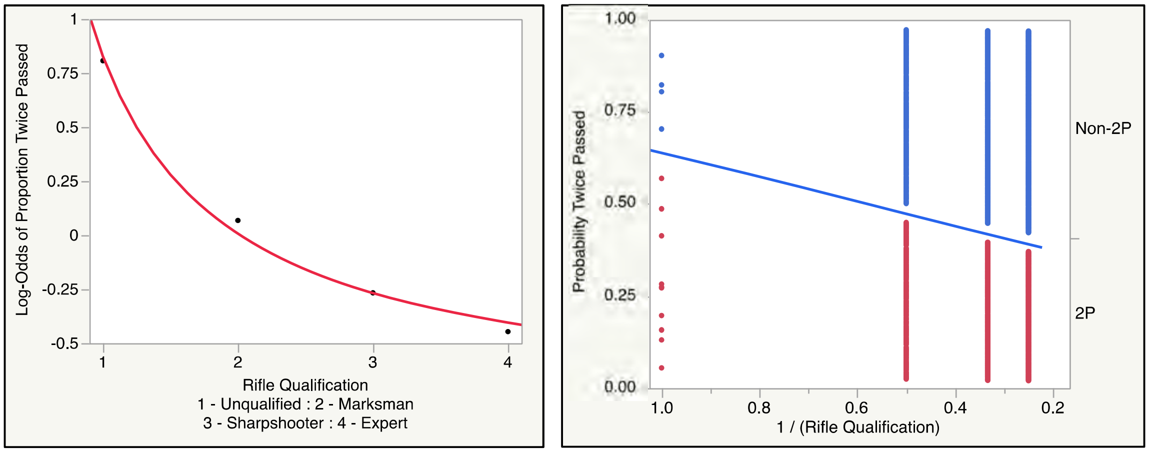

Figure 58. *Log-Odds and Logistic Fit of Staff Sergeants Twice-Passed (2P) by Rifle Qualification.* Log-Odds shows a reciprocal relationship with Rifle Qualification. The univariate logistic regression shows a lower rifle qualification is correlated to a higher likelihood of Staff Sergeants twice-passed (Chi-Squared = 28; p-value < 0.01).

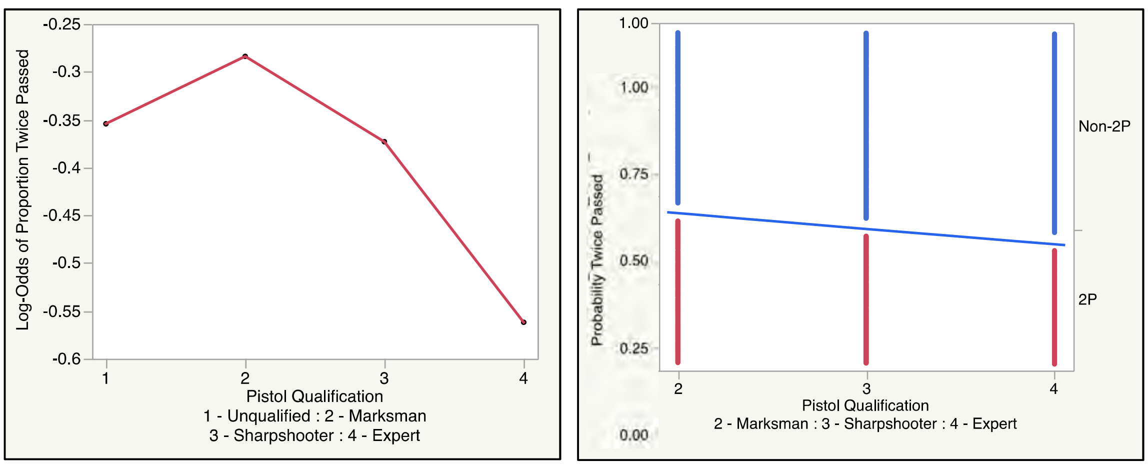

Figure 59. *Log-Odds and Logistic Fit of Staff Sergeants Twice-Passed (2P) by Pistol Qualification.* Log-Odds shows a split relationship between unqualified and qualified Marines, so a dichotomous interaction is created. The univariate logistic regression shows that, among qualified Marines, lower pistol qualification is correlated to a higher likelihood of Staff Sergeants twice-passed (Chi-Squared = 41; p-value < 0.01).

D. DICHOTOMOUS VARIABLES

Table 20. *Proportion of Staff Sergeants Twice Passed (2P) by Additional Relevant Variables.* A Commanding General Certification for reenlistment correlates to a higher proportion of Staff Sergeants twice-passed. Being Female, having more than a high school education, or being a Purple Heart recipient correlates to a lower proportion of Staff Sergeants twice-passed.

	TRUE		**FALSE**		**p-value**
	Count	*Proportion Twice-Passed*	*Count*	*Proportion Twice-Passed*	*Likelihood Ratio*
Bronze Star or Greater	280	39.6 %	7,871	40.7 %	0.72
Commanding General Certification	109	74.3 %	8,042	40.2 %	< 0.01
Gender (Female)	456	36.4 %	7,695	40.9 %	0.06
Greater Than High School Education	548	33.9 %	7,603	41.1 %	< 0.01
Hispanic	1,417	40.4 %	6,734	40.7 %	0.81
Purple Heart Recipient	172	27.3 %	7,979	40.9 %	< 0.01

APPENDIX E. JMP REGRESSION RESULTS

A. MIN-BIC NOMINAL LOGISTIC MODEL

Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	630.4758	8	1260.952	<.0001*
Full	3790.5226			
Reduced	4420.9984			

RSquare (U)	0.1426
AICc	7599.07
BIC	7660.14
Observations (or Sum Wgts)	6557

Measure	Training	Definition
Entropy RSquare	0.1426	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2363	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5781	∑ -Log(ρ[j])/n
RMSE	0.4447	√ ∑(y[j]-ρ[j])^2/n
Mean Abs Dev	0.3952	∑ |y[j]-ρ[j]|/n
Misclassification Rate	0.3104	∑ (ρ[j]≠ρMax)/n
N	6557	n

Lack Of Fit

Source	DF	-LogLikelihood	ChiSquare
Lack Of Fit	6371	3700.9096	7401.819
Saturated	6379	89.6130	Prob>ChiSq
Fitted	8	3790.5226	<.0001*

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	3.27859363	0.3794698	74.65	<.0001*
Reciprocal(RecLevel)	12.0512465	0.9237787	170.19	<.0001*
AFQT	-0.0088487	0.0016227	29.73	<.0001*
Log(MCMAPnoInst)	-0.642212	0.0732341	76.90	<.0001*
PFTS	-0.0172869	0.0009297	345.71	<.0001*
Taped[0]	-0.1764918	0.0352076	25.13	<.0001*
AdverseInGrade 2[0]	-1.2151159	0.0925585	172.35	<.0001*
PriorAdverse[0]	-0.1196707	0.0370539	10.43	0.0012*
Race_Black[0]	-0.2026608	0.0349974	33.53	<.0001*

Figure 60. *Min-BIC Nominal Logistic Regression Model*. JMP output for the selected Min-BIC logistic regression model.

Unit Odds Ratios

Per unit change in regressor

Term	Odds Ratio	Lower 95%	Upper 95%	Reciprocal
Reciprocal(RecLevel)	171312.8	28707.76	1072854	5.8373e-6
AFQT	0.99119	0.988038	0.994343	1.0088879
Log(MCMAPnoInst)	0.526127	0.455656	0.607206	1.9006806
PFTS	0.982862	0.981063	0.984645	1.0174372

Range Odds Ratios

Per change in regressor over entire range

Term	Odds Ratio	Lower 95%	Upper 95%	Reciprocal
Reciprocal(RecLevel)	5.03e+15	2.37e+13	1.23e+18	1.989e-16
AFQT	0.501478	0.391139	0.642446	1.9941058
Log(MCMAPnoInst)	0.040314	0.019642	0.082543	24.805368
PFTS	0.037459	0.026447	0.052863	26.69618

Odds Ratios for Taped

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	1.4233077	<.0001*	1.2396755	1.6338184
0	1	0.7025888	<.0001*	0.6120631	0.8066627

Odds Ratios for AdverseInGrade 2

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	11.361515	<.0001*	7.9942045	16.545633
0	1	0.0880164	<.0001*	0.0604389	0.1250906

Odds Ratios for PriorAdverse

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	1.2704123	0.0013*	1.0983561	1.4686939
0	1	0.787146	0.0013*	0.6808771	0.9104516

Odds Ratios for Race_Black

Level1	/Level2	Odds Ratio	Prob>Chisq	Lower 95%	Upper 95%
1	0	1.4997846	<.0001*	1.3073976	1.7202291
0	1	0.6667624	<.0001*	0.5813179	0.7648783

Figure 61. *Min-BIC Odds Ratios*. JMP output of the odds-ratios for the Min-BIC logistic regression model.

B. P-VALUE < 0.05 NOMINAL LOGISTIC MODEL

Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	645.4256	13	1290.851	<.0001*
Full	3775.5728			
Reduced	4420.9984			

RSquare (U)	0.1460
AICc	7579.21
BIC	7674.18
Observations (or Sum Wgts)	6557

Measure	Training	Definition
Entropy RSquare	0.1460	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2414	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5758	$\sum$ -Log(ρ[j])/n
RMSE	0.4436	$\sqrt{\sum (y[j]-\rho[j])^2/n}$
Mean Abs Dev	0.3932	$\sum$ |y[j]-ρ[j]|/n
Misclassification Rate	0.3046	$\sum$ (ρ[j]≠ρMax)/n
N	6557	n

Lack Of Fit

Source	DF	-LogLikelihood	ChiSquare
Lack Of Fit	6507	3757.5510	7515.102
Saturated	6520	18.0218	Prob>ChiSq
Fitted	13	3775.5728	<.0001*

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	4.08149551	0.4358946	87.67	<.0001*
Reciprocal(RecLevel)	11.8182746	0.9277089	162.29	<.0001*
CGCert[FALSE]	-0.4237475	0.1421537	8.89	0.0029*
Infantry[0]	-0.1221257	0.0432077	7.99	0.0047*
AFQT	-0.0081186	0.0016434	24.40	<.0001*
PistolRank	-0.0814917	0.0351403	5.38	0.0204*
Log(MCMAPnoInst)	-0.6258109	0.0736924	72.12	<.0001*
PFTS	-0.0173523	0.0009363	343.49	<.0001*
MoreThanHS[0]	0.11792826	0.0581777	4.11	0.0427*
Taped[0]	-0.1776108	0.0353185	25.29	<.0001*
AdverseInGrade 2[0]	-1.1908755	0.0931597	163.41	<.0001*
PriorAdverse[0]	-0.1235132	0.03719	11.03	0.0009*
Race_Black[0]	-0.202859	0.0356736	32.34	<.0001*
Race_Asian[0]	-0.1705288	0.0832569	4.20	0.0405*

Figure 62. *P-value Nominal Logistic Regression Model*. JMP output for the p-value logistic regression model.

C. MIN-AIC NOMINAL MODEL

Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	649.1329	16	1298.266	<.0001*
Full	3771.8654			
Reduced	4420.9984			

RSquare (U)	0.1468
AICc	7577.82
BIC	7693.13
Observations (or Sum Wgts)	6557

Measure	Training	Definition
Entropy RSquare	0.1468	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.2426	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5752	∑ -Log(ρ[j])/n
RMSE	0.4433	√ ∑(y[j]-ρ[j])²/n
Mean Abs Dev	0.3927	∑ ly[j]-ρ[j]l/n
Misclassification Rate	0.3059	∑ (ρ[j]≠ρMax)/n
N	6557	n

Lack Of Fit

Source	DF	-LogLikelihood	ChiSquare
Lack Of Fit	6520	3764.9340	7529.868
Saturated	6536	6.9315	Prob>ChiSq
Fitted	16	3771.8654	<.0001*

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	3.65686037	0.4662178	61.52	<.0001*
Reciprocal(RecLevel)	11.7502382	0.9272645	160.58	<.0001*
CGCert[FALSE]	-0.420746	0.14224	8.75	0.0031*
Infantry[0]	-0.1134832	0.0436329	6.76	0.0093*
Comm[0]	0.06166425	0.0436415	2.00	0.1577
AFQT	-0.0080847	0.0016457	24.13	<.0001*
Reciprocal(RifleLevel)	0.58599411	0.3255394	3.24	0.0718
PistolRank	-0.0816666	0.0376312	4.71	0.0300*
PistolBinary[Qualified]	0.18667138	0.1269513	2.16	0.1414
Log(MCMAPnoInst)	-0.6194036	0.073931	70.19	<.0001*
PFTS	-0.0172866	0.0009375	339.98	<.0001*
MoreThanHS[0]	0.12153913	0.0582347	4.36	0.0369*
Taped[0]	-0.1786901	0.0353329	25.58	<.0001*
AdverseInGrade 2[0]	-1.1951381	0.0931699	164.55	<.0001*
PriorAdverse[0]	-0.126122	0.037248	11.47	0.0007*
Race_Black[0]	-0.1964649	0.0358078	30.10	<.0001*
Race_Asian[0]	-0.1669257	0.0833699	4.01	0.0453*

Figure 63. *Min-AIC Nominal Logistic Regression Model*. JMP output for the selected Min-AIC logistic regression model.

LIST OF REFERENCES

Asch, B. J., Romley, J. A., & Totten, M. E. (2005). *The quality of personnel in the enlisted ranks.* Santa Monica, CA: RAND Corporation.

Bartholomew, D. J. (1971). The statistical approach to manpower planning. *Journal of the Royal Statistical Society. Series D (The Statistician) , 20* (1), 3–26.

Bartholomew, D. J., Forbes, A. F., & McClean, S. I. (1991). *Statistical techniques for manpower planning* (2nd Edition ed.). New York: Wiley.

Branch, G. F., Hanushek, E. A., & Rivkin, S. G. (2013). School leaders matter: Measuring the impact of effective principals. *Education Next* (13), 62–69.

Christmas, G. R. (1994, July 21). *Marine Corps "up or out" promotion/retention policy. [LtGen George. R. Christmas, Deputy Chief of Staff, M&RA memorandum to Frederick F. Y. Pang, Assistant Secretary of the Navy (M&RA)]*. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Christmas, G. R. (1995, October 24). *[LtGen George R. Christmas, Deputy Chief of Staff, M&RA memorandum to Gen Charles C. Krulak, CMC]*. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Cole, A. L. (2014). *U.S. Marine Corps enlisted retention: an analysis of stakeholder incentives for the retention of tier 1 first-term Marines.* Monterey, CA: Naval Postgraduate School.

Department of Defense. (2012). *Continuation of commissioned officers on active duty and on the reserve active-status list.* DoD Instruction Number 1320.08. Washington DC: Department of Defense.

Dornan, R. K. (1996, February 13). *[Rep. Robert K. Dornan, Chairman, Military Personnel Subcommittee letter to Gen. Charles C. Krulak, Commandant of the Marine Corps]*. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Dunford, J. F. (2015). *36th Commandant's planning guidance*. Quantico, VA: USMC.

Enlisted Assignment Branch, Manpower & Reserve Affairs (MMEA). (2014, August 13). *Fiscal Year (FY) 2015 enlisted retention guidelines for the Subsequent Term Alignment Plan (STAP).* Quantic, VA: USMC.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (1991). *Comprehensive review and restructuring of Marine Corps enlisted high year of tenure (HYT) and promotion policies.* [Decision Brief]. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20, Quantico, VA.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (1994, June 23). *Phase II of Marine Corps transition to enlisted "up or out" retention/promotion policy.* [Decision Brief]. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (1996). *ALMAR 163/96: Marine Corps up or out policy for Staff Sergeants.* [ALMAR]. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20, Quantico, VA.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (1999). *Twice-passed (2P) Staff Sergeant retention policy.* [Decision Paper]. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20, Quantico, VA.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (2014a, May 19). *MARADMIN 242/14: FY14 Staff Sergeant retention board.* Retrieved January 25, 2015, from Official U.S. Marine Corps website: http://www.marines.mil/News/Messages/MessagesDisplay/tabid/13286/Article/164388/fy14-staff-sergeant-retention-board.aspx.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (2014b, September 25). *MCBUL 5314: Enlisted Career Force Controls (ECFC) program.* Retrieved January 25, 2015, from Official U.S. Marine Corps website: http://www.marines.mil/News/Messages/MessagesDisplay/tabid/13286/Article/170968/mcbul-5314-enlisted-career-force-controls-ecfc-program.aspx.

Enlisted Plans Section, Manpower Plans, Programs, and Budget Branch (MPP-20). (2014c, June 20). *MCBUL 7220: Fiscal Year 2015 (FY15) Selective Reenlistment Bonus/(SRB) Program and FY15 Broken Service SRB (BSSRB) Program.* Retrieved January 25, 2015, from Official U.S. Marine Corps website: http://www.marines.mil/News/Messages/MessagesDisplay/tabid/13286/Article/166215/mcbul-7220-fiscal-year-2015-fy15-selective-reenlistment-bonussrb-program-and-fy.aspx.

Ergun, L. (2003). *An analysis of officer accession programs and the career development of U.S. Marine Corps officers.* Monterey, CA: Naval Postgraduate School.

Goodall, A. H., & Pogrebna, G. (2015). Expert leaders in a fast moving environment. (K. Lowe, Ed.) *The Leadership Quarterly* (26), 123–142.

Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression* (2nd ed.). New York: John Wiley & Sons, Inc.

Hurst, S. S., & Manion, T. E. (1985). *Use of a binary choice model to determine Marine officer attrition*.Monterey, CA: Naval Postgraduate School.

Kalamatianou, A. G. (1987). Attainable and maintainable structures in Markov manpower systems with pressure in the grades. *The Journal of the Operational Research Society , 38* (2), 183–190.

Krulak, C. C. (1996, March 19). *2-P S/Sgt. [Gen Charles C. Krulak, CMC, e-mail to LtGen G. Ronald Christmas, Deputy Chief of Staff, M&RA]*. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Lange, L. F. (1996, January 29). *2P SSgt [Col Lee F. Lange II, Branch Head, MPP, memorandum to LtCol Grant R. Stewart, Section Head, MPP-20]*. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Lazear, E. P., Shaw, K. L., & Stanton, C. T. (2012, August). The value of bosses. *NBER Working Paper Series*. Cambridge, MA: National Bureau of Economic Research.

Licari, A. D. (2013). *Developing a Markov model for forecasting end strength of Selected Marine Corps Reserve (SMCR) officers.* Monterey, CA: Naval Postgraduate School.

Mabus, R. (2015, May 13). *DoN talent management address to the brigade of midshipmen.* Retrieved May 14, 2015, from Official website of the United States Navy: http://www.navy.mil/navydata/people/secnav/Mabus/Speech/USNA%20Talent%20Management%20Speech_FINAL.pdf.

Nguyen, V. O. (1997). *Analysis of the U.S. Marine Corps' steady state Markov model for forecasting annual first-term enlisted classification requirements.* Monterey, CA: Naval Postgraduate School.

Ouellette, M. (1999, August 23). *2P SSgt retention policy. [SgtMaj Mark Ouellette, Sergeant Major, M&RA memorandum to LtGen Jack W. Klimp, Deputy Chief of Staff, M&RA]*. 2P Staff Sergeant Retention Policy, 1991–1999. Archives of MPP-20. Quantico, VA.

Owan, H., Takahashi, S., Tsuru, T., & Uehara, K. (2014, June). *Finding good managers: An econometric case study of a large Japanese auto dealership.* Tokyo: Institute of Economic Research, Hitotsubashi University.

Raymond, J. D. (2006). *Determining the number of reenlistments necessary to satisfy future force requirements.* Monterey, CA: Naval Postgraduate School.

Sales, P. (1971). The validity of the Markov chain model for a class of the civil service. *Journal of the Royal Statistical Society. Series D (The Statistician) , 20* (1), 85–110.

Sanborn, J. K. (2014, July 14). *One-Third of Boarded Staff Sergeants Get The Ax.* Retrieved March 31, 2015, from Marine Corps Times: http://archive.marinecorpstimes.com/article/20140714/CAREERS02/307140026/One-third-boarded-staff-sergeants-get-ax.

SAS Institute Inc. (n.d.). *Statistical details: Assess variable importance*. Retrieved April 12, 2015, from jmp: http://www.jmp.com/support/help/Statistical_Details.shtml#418531.

Stoloff, P. (1983). *Officer selection study*. Alexandria, VA: Center for Naval Analyses.

Tivnan, B. F. (1998). *Optimizing United States Marine Corps enlisted assignments.* Monterey, CA: Naval Postgraduate School.

Under Secretary of Defense, Personnel & Readiness. (2015). *January 2015 Active Duty Pay Table.* Retrieved April 13, 2015, from Military Compensation: http://militarypay.defense.gov/pay/basic/activeduty.aspx.

Under Secretary of Defense, Personnel & Readiness. (n.d.). *Retirement.* Retrieved April 13, 2015, from Military Compensation: http://militarypay.defense.gov/retirement.

United States. (1996, February 10). U.S. Code, Title: 10, Subtitle: A, Chapter: 59, Section: 1176.

Whelan, G. J. (2013, June). *Forecasting Army enlisted ETS losses.* Monterey, California: Naval Postgraduate School

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